

Republic of Nicaragua

FY 2016 External Ex-Post Evaluation of Japanese Grant Aid Project
“The Project for Reconstruction of Bridges on Managua-El Rama Road”

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0. Summary

The Project for Reconstruction of Bridges on Managua-El Rama Road (hereinafter referred to as “the Project”) was implemented for the purpose of securing safe and smooth traffic between Managua and El Rama on National Highway No. 7 which is an international trunk road passing through Nicaragua by means of rebuilding three bridges, thereby contributing to the vitalization of domestic and international logistics and also to the promotion of the local economy along the route. At the time of both planning and ex-post evaluation, the Project is fully consistent with the national development policies, the transport sector policies and development needs of Nicaragua and with Japan’s ODA policies and, therefore, its relevance is high. The outputs are generally as planned, and both the total project cost and project period were within the plan, thus the efficiency of the Project is high. The assumed effects of the Project, namely, traffic congestion before the bridge, and time for cars to cross the bridge improved significantly. On the other hand, although considerable improvements can be recognized for the temporal stoppage before entering the bridge as well as the average travelling speed on the bridge, these have not been fully eliminated as originally planned, because speed reduction zones were introduced by the Nicaraguan government after the completion of the Project in order to ensure the safety of local residents crossing the road. In addition, the risk of bridge collapsing due to aging has been eliminated. The assumed impacts on the promotion of the local economy along the route and vitalization of domestic and international logistics are confirmed. As the implementation of the Project has generally produced the planned effects, the effectiveness and impacts of the Project are high. The institutional, technical and financial aspects of the entities that are in charge of the Project’s operation and maintenance, that is the Ministry of Transportation and Infrastructure (Ministerio de Transporte e Infraestructura: MTI), Road Maintenance Fund (Fondo de Mantenimiento Vial (FOMAV) and the Corporation of Regional Construction Companies (Corporación de Empresas Regionales de la Construcción: CORECO), as well as the current status of operation and maintenance of the Project are generally good and the sustainability of the effects of the Project is high.

In line of the above, the Project is highly satisfactory.

1. Project Description



Project Location



Las Banderas Bridge:
Primary school children crossing the bridge
to attend school

1.1 Background

Nicaragua completely abolished its railway network in the 1990's and 98% of passenger and freight transportation relied on roads at the time of project planning (2010). However, the transportation infrastructure, including trunk roads, bridges, farm roads, etc., was insufficient, partly because of the after-effects of the civil war in the 1980's. The level of road network development was the lowest among countries in Central America. Even though roads and bridges had been improved by a number of donors, there were still bridges damaged by flooding, vehicle collision, etc.

Meanwhile, the Mesoamerica Integration and Development Project (Mesoamerica Project: MP) was formulated in 2001, incorporating a scheme to construct an international trunk road connecting Puebla in Mexico all the way to Panama (see "3.1.1 Consistency with the Development Policies of Nicaragua" for further details). In accordance with this scheme, the countries involved have proceeded with road improvement work for the purpose of vitalizing logistics in Central and South America and it was necessary for Nicaragua to follow suit. The Project forms part of the Atlantic Corridor and East-West Corridor, both of which are international trunk roads perceived in the scheme.¹ While the roads in these corridors have been improved by many donors², the three bridges targeted by the Project were more than 60 years old and their deterioration was aggravated by damage caused by Hurricane Mitch in 1998 to the point of their use being dangerous. These bridges were narrow and trucks and other large vehicles could not pass each other on the bridge, hampering smooth traffic flow.

¹ National Highway No. 7 where the bridges of the Project are located, are part of the East-West Corridor lining the Pacific Ocean side and Caribbean Seaside of Nicaragua. The section between Managua and Lovago also forms part of the Atlantic Corridor, an international trunk road in Central America. This Atlantic Corridor runs southwards from Lovago as National Highway No. 25 to link with Costa Rica. Meanwhile, the East-West Corridor continues from Lovago to El Rama to the east as National Highway No. 7.

² See "Relevant Projects: Other donors" in the table in the Project Outline.

Against this background, the Government of Nicaragua made a request for a grant aid cooperation to the Government of Japan in July 2008 for the rebuilding of the three bridges in question. In response, the Japan International Cooperation Agency (JICA) conducted the Preparatory Study (Preliminary Investigation) in October 2009 and the Preparatory Study (Basic Design) in January 2010.

1.2 Project Outline

The purpose of the Project was to secure safe and smooth traffic between Managua and El Rama on the Atlantic and East-West Corridors by means of rebuilding three bridges, thereby contributing to the vitalization of domestic and international logistics and also to the promotion of the local economy along the route.



Source: Executing Agency

Fig. 1 Location of the Three Bridges on the National Highway No.7 (East-West Corridor)

Grant Limit/Actual Grant Amount	(Detailed Design) 62 million yen / 61 million yen (Construction) 1,878 million yen / 1,261 million yen
Exchange of Notes Date Grant Agreement Signing Date	(Detailed Design) December 2010 (Construction) June 2011
Executing Agency	Ministry of Transport and Infrastructure

Project Completion Date		July, 2013
Project Implementation Entities	Main Contractors	Fujita-Kawada Joint Venture
	Main Consultant	CTI Engineering International Co., Ltd.
Basic Design Study		January 2010-October 2010
Related Projects		<p>[Technical Cooperation] Project for the Study of National Transport Plan in the Republic of Nicaragua (2012-2014)</p> <p>[Grant Aid] Project for Reconstruction of Bridges on Principal Trunk Roads (E/N: May 2000); Project for Reconstruction of Principal Bridges on National Highway No.7 (E/N: June 2007); Project for Construction of the Santa Fe Bridge in the Republic of Nicaragua (E/N: May 2010)</p> <p>[Other Organizations] Rehabilitation of the San Benito-San Lorenzo Road (Danish International Development Agency, 1999-2003); Rehabilitation of the Muhan-El Rama Road (World Bank, 2002-2003); Rehabilitation of the San Lorenzo-Muhan Road (Inter-American Development Bank (IDB), 2003-2005)</p>

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiromi Suzuki S. (IC Net Limited)

2.2 Duration of the Evaluation Study

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

Duration of the Study: October 2016 to February 2018

Duration of the Field Survey: 19th February to 2nd March and 26th to 30th July 2017

3. Results of Evaluation (Overall Rating: A³)

3.1 Relevance (Rating: ③⁴)

3.1.1 Consistency with the Development Policies of Nicaragua

The national development plan of Nicaragua at the time of the planning of the Project was the *National Human Resources Development Plan (2008-2012)* in which “the development of such economic infrastructure as roads, bridges, etc.” was considered to be an important means of achieving the target for “productivity improvement”. The “Mesoamerica Project” and the “*Program to Strengthen the Transportation Network of Trunk Roads*” were the two principal policies of the transportation sector at the time. The former was a wide area development

³ A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

⁴ ①: Low; ②: Fair; ③: High

project⁵ aimed at vitalizing logistics in Central America and the latter was an infrastructure policy for transportation formulated by the Ministry of Transport and Infrastructure (Ministerio de Transporte e Infraestructura: MTI). Both emphasized the development of the Pacific Corridor and Atlantic Corridor where the Project sites were located from the viewpoint of developing a transportation network of trunk roads, including international trunk roads.

The national development plan at the time of ex-post evaluation is the *National Human Resources Development Plan (2012-2016)* and the development of transport infrastructure is included in its 12 principal strategies and policies. In addition to the continuous improvement of semi-trunk roads and bridges and the development of basic road networks and transport infrastructure, one of the targets of this national plan is the continuous improvement of the East-West Corridor linking the Pacific side and Atlantic side of Nicaragua. The *Long-Term National Transport Plan*⁶ (2014-2033) of the MTI considers roads and bridges to be essential infrastructure to ensure the sustainable growth of the national economy and to reduce disparities between the eastern and western areas of Nicaragua. It lists such strategies as the development of reliable road networks, strengthening of the trunk road network and international corridors, strengthening of road functions to improve the vulnerability to disasters and strengthening of the road maintenance system. Regarding the road improvement of the East-West Corridor, where the Project is located, the intended work includes repair of the road linking El Rama and Laguna de Perlas and the construction of new bridges. As these works proceed, the role as an international trunk road of the East-West Corridor, including the section where the Project is located, is expected strengthen and increase. In addition, as the high level of traffic accidents is considered to be a social problem in Nicaragua, an action plan for the safety of road transport is included in this transport plan.

As described above, the development policies of Nicaragua at the time of both ex-ante evaluation and ex-post evaluation consider the improvement of transport infrastructure, including roads and bridges, to be essential for economic development and productivity improvement. Therefore, the Project consistency is secured.

3.1.2 Consistency with the Development Needs of Nicaragua

The road section between Managua and El Rama where the subject bridges of the Project are located is a major trunk road connecting four departments (Managua, Boaco, Chontales and South Caribbean Coast Autonomous Region) which account for approximately one-third of the country's total population. Areas along the route are rich with agriculture and the livestock

⁵ The *Mesoamerica Project* is a wide area development initiative succeeding the Plan Puebla Panama which was jointly announced by Central American countries and Mexico in June 2001. At the time of ex-post evaluation, the Pacific Corridor and Atlantic Corridor, both of which form part of the "Mesoamerica International Road Network" aimed at vitalizing logistics and tourism in Central America, have been developed with IDB loans.

⁶ The *Long-Term National Transport Plan* was formulated based on the "Project for the Study on National Transport Plan in Nicaragua", a technical cooperation project (development study) of JICA implemented in 2014.

industry and the road is linked to Port of Arlen Siu, the principal port of El Rama on the Atlantic side.⁷ However, as described in “1.1 Background”, the target bridges of the Project were highly deteriorated to the point of the risk of collapse. Moreover, their narrow width forced vehicles to stop on both sides of the bridge, creating a bottleneck. The delayed improvement of the road and bridges in this section became an obstacle to not only the smooth domestic as well as international logistics but also to socioeconomic development. There was a strong need for bridge improvement from the viewpoint of safety and economic development.

At the time of ex-post evaluation, while the bottlenecks posed by these three bridges have been eliminated, this section maintains its high level of importance from the viewpoint of vitalizing domestic and international logistics and also of promoting the local economy.

Based on the above, the Project is highly consistent with the development needs of Nicaragua at the time of both planning and ex-post evaluation.

3.1.3 Consistency with Japan’s ODA Policy

Japan’s Country Assistance Program for Nicaragua formulated in 2002 through discussions with the Government of Nicaragua adopted the basic policy of providing cooperation for a reduction of poverty and economic disparities, improvement of the socioeconomic infrastructure, support for democratization and strengthening of the disaster prevention capacity in view of the facts that the negative impacts of the long-fought civil war still remained and that the country suffered from many natural disasters. At the same time, the Program called for consistency with Japan’s assistance for regional integration efforts led by the Central American Integration System. As the Program identified six priority areas, including improvement of the road and transport infrastructure, the Project as a road and transport infrastructure improvement project is highly consistent with Japan’s ODA policies.

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

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

The outputs of the Japanese portion were generally achieved as planned (Table 1).⁸

⁷ The Port of Arlen Siu is a river port located some 100 km inland of the Caribbean Coast (Atlantic Coast) and plays an important role in the international logistics of goods between Nicaragua and the Caribbean Sea (Atlantic Ocean).

⁸ The only major change was lengthening of three caisson piles for the abutment of La Tonga Bridge from 6.5 m to 8.5 m based on the findings of an additional boring survey which was conducted to verify the different geological features discovered during the construction work.

Table 1 Outputs of the Japanese Portion: Planned and Actual

Item	Planned			Actual	
	Las Banderas Bridge Tipitapa, Managua	Tecolostote Bridge San Lorenzo, Boaco	La Tonga Bridge Juigalpa, Chontales		
General Contents	Change to a two-lane bridge	Construction of a new one-lane bridge parallel to the existing one-lane bridge	Change to a two-lane bridge	As planned for all three bridges	
Road Standard	Trunk Road	Trunk Road	Trunk Road		
Design Speed	80 (km/h)	80 (km/h)	80 (km/h)		
Design Live Load	Equivalent to an increase by 25% of HS20-44 (Live Load B)	Equivalent to an increase by 25% of HS20-44 (Live Load B)	Equivalent to an increase by 25% of HS20-44 (Live Load B)		
Bridge Length	100.5 (m)	100.8 (m)	99.7 (m)		
Span Length	48.9+24.3+24.3 (m)	25.0+50.0+25.0 (m)	32.3+32.3+32.3 (m)		
Width	12.330 (m)	7.130 (m)	12.330 (m)		
Superstructure	Simple steel through truss bridge/PC2 span continuous girder I bridge	Steel 3 span continuous iron girder bridge	PC3 span continuous girder I bridge		
Substructure	Inverted T-type abutment Oval wall type pier	Inverted T-type abutment Oval wall type pier	Inverted T-type abutment Oval wall type pier		
Foundation Structure	Spread Foundation	Spread Foundation	Spread Foundation Caisson pile (diameter 2.5m, length 6.5m)	Only at La Tonga Bridge, the length of the three caisson piles was changed to 8.5m	
Access Road	Extension at Starting Point	144.0 (m)	241.0 (m)	168.8 (m)	As planned for all of three bridges
	Extension at End Point	155.5 (m)	298.2 (m)	371.5 (m)	

* Source: document provided by JICA

The outputs of the Nicaraguan portion included the acquisition of land, resettlement, relocation of communication facilities, relocation of electricity poles and cables, relocation of water pipes (at Las Banderas Bridge and Tecolostote Bridge) and other (removal of existing bridges). According to the MTI, the planned outputs were generally achieved except for the following changes and additions.

- Because the number of commercial premises illegally occupying the planned construction sites had increased since the time of project planning, the scale of land acquisition and resettlement increased.

- For the relocation of electricity poles and cables, it was decided to lay the cables underground without using poles to increase the travelling safety of medium size and large trucks.
- Because of changes of the detour routes, the work to repair walls, fencing, etc. of buildings along the new detours was added.
- At the time of improving the access roads to Tecolostote Bridge, it was found that the site of the Tecolostote Secondary School located next to the bridge partly occupied the right of way for the national highway. In return for the transfer of this site by moving the boundary line of the school⁹, the MTI agreed with the school to improve the perimeter fencing, multi-purpose ground and infrastructure (staircases, handrails, benches, etc.) near the entrance to the school and conducted the necessary work except for some items.

All of the above changes and additions to the output were necessary in order to secure safe and smooth traffic at the target bridges. Meanwhile, the changes and additions of the Nicaragua portion were necessary and appropriate in order to minimise any negative impacts of the Project on local residents and the environment.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned total project cost at the time of planning was 1,949 million yen (Japanese portion of 1,878 million yen and Nicaraguan portion of 71 million yen). The actual total project cost was 1,333 million yen (Japanese portion of 1,261 million yen and Nicaraguan portion of 72 million yen) which was 63% of the planned cost.

As far as the Japanese portion of the Project is concerned, although the construction cost increased because of the lengthening of three caisson piles for the abutment of La Tonga Bridge and increase quantity of superstructure for each bridge, the final amount of the Japanese portion was within the planned cost due mainly to the appreciation of the yen.¹⁰

The final Nicaraguan portion of the project cost exceeded the planned cost, partly because of underestimation of the removal cost of the existing bridges¹¹ at the time of planning, in turn

⁹ As part of the premises of the Tecolostote Secondary School occupied the right of way for the national highway, no compensation would have been necessary in a normal situation. It was impossible to obtain more detailed and accurate information on the background for this agreement.

¹⁰ The exchange rate of 91.36 yen to US\$ 1 at the time of the Preparatory Study changed to 83.73 yen to US\$ 1 at the time of the Detailed Design.

¹¹ This included the repair and reinforcement of the existing Tecolostote Bridge, demolition and removal of the existing La Tonga Bridge and repair and reinforcement of the existing Cuisalá Bridge. The rebuilding of Cuisalá Bridge was removed from the scope of the Project as the Preliminary Study conducted in 2009 found the work to be less urgent in reference to its structural safety and transport function. However, the implementation of the

due to the lack of a detailed survey, and partly because of the increased prices of some equipment and materials. The cost of land acquisition, resettlement and relocation of communication and utility poles and water pipes was within the planned cost despite some changes of the planned contents and additions.

Table 2 Project Cost: Planned and Actual

(Unit: million yen)

Item	Planned	Actual
【Japanese Portion】		
Construction Cost	1,878	1,190
Design and Supervision Cost		72
Sub-total	1,878	1,261
【Nicaraguan Portion】		
Land Acquisition, Resettlement	16	12*
Relocation of communication, utility poles and water pipes	26	7
Other (Removal of the existing bridge, etc.)	29	56
Sub-total	71	72
Grand Total	1,949	1,333

Source: The planned cost for the Japanese portion is based on the E/N. The planned cost for the Nicaraguan portion is based on the report for the Preparatory Study. The actual cost for the Japanese portion is based on documents provided by JICA. The actual cost for the Nicaraguan side is based on documents provided by MTI.

Note: At the time of quantity survey: Foreign exchange rate as of March 2010: US\$1=91.36 Yen
At the time of ex-post evaluation: 1 Cordoba=3.5181Yen (monthly average rate from January 2011 to July 2013; source: IMF data).

* The construction cost of fencing, multi-purpose ground and infrastructure (staircases, handrails, benches, etc.) for the Tecolostote Secondary School accounted for some 14% (1.7 million yen) of the land acquisition and resettlement cost.

3.2.2.2 Project Period

The cooperation period, including the detailed design and tender periods, assumed at the time of planning was from October 2010 to June 2013 (two years and nine months or 33 months). The actual period was from December 2010 when the grant agreement was signed, to July 2013 (two years and eight months or 32 months) which was within the planned period (97% of the planned period).¹²

Based on the above, both the Project cost and the Project period were as planned. Therefore, the efficiency of the Project is high.

repair and reinforcement of five items was recommended and it was agreed that this work would be conducted at the expense of the Nicaraguan side.

¹² Because of the lack of information on the overall construction period and that on individual components of the Nicaraguan portion, project completion was defined as the completion and approval of the final inspection of the three bridges. Regarding the Project period by stage was, 91% of the planned period from the detail design to signing of contract for the main works; as for the construction period, it was 86% compared to the planned period for Las Banderas Bridge, 90% for Tecolostote Bridge, and 83% for La Tonga Bridge. As can be seen, all bridges were within the planned period.

3.3 Effectiveness¹³ (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

The principal objective of the Project was “to secure safe and smooth transport” and there were three main indicators for the project effect: “improvement of the average travelling speed”, “elimination of the temporary stoppage of vehicles before the bridge” and “reduction of the river crossing time by vehicles”. In this ex-post evaluation, four auxiliary indicators were added, taking the contents of the report for the Preparatory Study into consideration. These are “increase of the traffic volume”, “elimination of traffic paralysis due to flooding, etc.”, “reduction of traffic accidents” and “prevention of the loss of human life due to bridge collapse”. Table 3 and Table 4 show the reference value, planned value and actual value for each of these indicators for the three bridges.

A) Main Effect Indicators

(1) Increase of the average travelling speed: At the time of planning, the target average travelling speed was set at between 60 km/hour and 80 km/hour which was the speed limit in Nicaragua. However, a traffic accident near Las Banderas Bridge¹⁴ led to the introduction after project completion by the Nicaraguan side of speed reduction zones with a maximum speed limit of 30 km/hour on both side of the target bridges of the Project. While these speed reduction zones have contributed to securing safe transport, the average travelling speed has decreased, which kept the target achievement rate between 38% to 57%. However, it must be noted that the introduction of these speed reduction zones has not caused any traffic jams which were a regular occurrence prior to the Project and the average travelling speed has increased compared to the pre-project period at all three bridges.



Speed reduction zone at Las Banderas Bridge (towards El Rama)

¹³ The effectiveness is rated in consideration of not only the effects but also the impacts.

¹⁴ While the target bridges of the Project are on National Highway No. 7, they are located in the municipal areas of Tipitapa, San Lorenzo and Juigalpa and residential areas are spread on both sides of the river and road. There are also many schools, medical institutions and commercial premises on both sides of these bridges along the road. Because of this, residents cross the bridge and road on foot many times a day as National Highway No. 7 is part of their daily life. In August 2014, a primary school pupil was run over by a truck and died after crossing the highway near Las Banderas Bridge, triggering a protest by residents. In response to this protest, speed reduction zones were introduced on both sides of the three bridges rebuilt by the Project.

Table 3 Level of Achievement of Main Effect Indicators

Indicator	Reference value (2010)	Target/status to achieve three years after project completion (2016)	Actual 2016 three years after project completion (Target achievement rate; status of achievement)
(1) Improvement of average driving speed (km/h) (improvement of average driving speed entering to and departing from the bridge)			
Las Banderas	10-20 km/h	60-80 km/h	31 km/h (39%-52%)
Tecolostote	10-20 km/h	60-80 km/h	30km/h (38%-50%)
La Tonga	10-20 km/h	60-80 km/h	34 km/h (43%-57%)
(2) Elimination of the stoppage time before the bridge			
Las Banderas	Average stoppage time 2.5 minutes per bridge	None	20 seconds (87% improvement from the reference value)
Tecolostote	Average stoppage time 2.5 minutes per bridge	None	20 seconds (87% improvement from the reference value)
La Tonga	Average stoppage time 2.5 minutes per bridge	None	8 seconds (95% improvement from the reference value)
(3) Shortening of the average river crossing time per vehicle			
Las Banderas	2-5 minutes*	Shortened after the project completion	26 seconds (78%-91% improvement from the reference value)
Tecolostote	2-5 minutes *	Shortened after the project completion	24 seconds (80%-92% improvement from the reference value)
La Tonga	2-5 minutes *	Shortened after the project completion	16 seconds (87%-97% improvement from the reference value)

Source: The reference and target values are based on the ex-ante evaluation table and the report for the Preparatory Study. The actual values are based on the materials provided by MTI.

* The river crossing time by vehicle obtained from the results of the beneficiary survey was used as the reference value.

- (2) Elimination of the temporary stoppage of vehicles before the bridge: Prior to the Project, the average stoppage time on both sides of the bridge was 2.5 minutes at each bridge. It was assumed that the Project would eliminate this stoppage time before the bridge as all the bridges would become two lane bridges instead of single lane bridges. At the time of ex-post evaluation, the introduction of speed reduction zones at these bridges as explained earlier means that vehicles stop for an average of some 20 seconds before Las Banderas Bridge and Tecolostote Bridge and an average of eight seconds at La Tonga Bridge. Although temporary stoppage has not been totally eliminated due to the installation of speed reduction zone that is an exogenous factor, a substantial improvement between 87% and 95% has been achieved against the reference value.
- (3) Reduction of the river crossing time by vehicles (bridge crossing time): Because of the lack of a reference value in 2010 for this indicator, “an average river crossing time before the

Project” of 2 to 5 minutes which was information obtained by the beneficiary survey¹⁵, was used as the reference value.¹⁶ The actual value in 2016 was 26 seconds for Las Banderas Bridge, 24 seconds for Tecolostote Bridge and 16 seconds for La Tonga Bridge, showing a considerable improvement of 78% to 97% against the reference value. At the time of ex-post evaluation, even though the travelling speed has been reduced by the speed reduction zones, no traffic jams occur because of them. Therefore, the bridge crossing time has shortened and smooth traffic flow is observed at the moment of the ex-post evaluation.

B) Auxiliary Indicators

(1) Increase of the traffic volume (average annual daily traffic volume (AADT) vehicles/day):

The traffic volume recorded by the executing agency differs from that of the Preparatory Study and the traffic volume survey conducted at each bridge at the time of the ex-post evaluation. The executing agency’s traffic volume is data recorded at the monitoring points installed by the executing agency, and in addition to that, the location of such monitoring points is not located near the bridge. For example, although the monitoring points for Las Banderas Bridge and Tecolostote Bridge is inside the urban city, they are located slightly away from the bridges. On the other hand, the monitoring point of La Tonga Bridge is located in the rural area away from the urban area. Therefore, the traffic volume provided by the executing agency is not strictly comparable to the planned value data. However, as a request was made by the executing agency to use their data as official data for the purpose of ex-post evaluation, Table 4 lists both data provided by the executing agency and data obtained by the traffic volume survey¹⁷ conducted during the field survey of the ex-post evaluation which used the same method employed at the time of planning. Based on MTI data, only small vehicles passing La Tonga Bridge failed to achieve the target because of the reason stated above. However, based on the traffic volume survey using the same method employed for planning, it is confirmed that the traffic volume in 2017 far exceeds the reference value at every bridge.

¹⁵ The details of the beneficiary survey (drivers) is as follows: (1) survey period: 8th to 12th March 2017; (2) sample size: 50 drivers at each bridge (total of 150 drivers); (3) gender ratio: 94% male and 6% female at Las Banderas Bridge, 90% male and 10% female at Tecolostote Bridge and 98% male and 2% female at La Tonga Bridge; (4) age: some 70% of the drivers were in their thirties and forties at all bridges; (5) bridges used: “all three bridges” were 74% of the respondents, and “Las Banderas Bridge and Tecolostote Bridge” was 26 % for all drivers surveyed at Las Banderas Bridge; at Tecolostote Bridge, “all three bridges” accounted for 33% of respondents, “Tecolostote Bridge only” for 36% and “Las Banderas Bridge and Tecolostote Bridge” for 26%; for La Tonga bridge “all three bridges” accounted for 66% of respondents, and “La Tonga Bridge only” for 33%.

¹⁶ According to the findings of the beneficiary survey (drivers), although the average river crossing time used to be from 2 to 5 minutes before the Project, the problem was that all the old bridges had only one lane, which caused traffic congestions in order to cross the bridge, resulting in a traffic bottleneck. For example, during rainy season, traffic congestion uses to be even more severe, starting quite far before the bridge, and if the delay to reach the bridge due to congestion were included, the average river crossing time would even reach up to three hours.

¹⁷ For the ex-post evaluation, the traffic volume for 12 continuous hours was surveyed for a total of five days. The daily traffic volume obtained was then converted to AADT data using MTI data from fixed point monitoring stations on National Highway No. 7.

Table 4 Level of Achievement of Auxiliary Indicators

			Reference value (2010)	Target/status to achieve three years after project completion (2016)	Actual 2016 three years after project completion (Target achievement rate; status of achievement)
(1) Increase of bridge crossing traffic volume (AADT: units/day) *					
Las Banderas	MTI Data	Small	2,186units 1,256units	Increased after the project completion	3,352 units (154% of the reference value) 1,583 units (126% of the reference value)
		Large			
	Traffic Volume Survey for Ex-post Evaluation	Small			
		Large			
Tecolostote	MTI Data	Small	1,858 units 699 units	Increased after the project completion	2,173 units (117% of the reference value) 983 units (141% of the reference value)
		Large			
	Traffic Volume Survey for Ex-post Evaluation	Small			
		Large			
La Tonga	MTI Data	Small	4,369 units 784 units	Increased after the project completion	2,036 units (47% of the reference value) 786 units (100% of the reference value)
		Large			
	Traffic Volume Survey for Ex-post Evaluation	Small			
		Large			
(2) Annual number of traffic paralyzes (due to flooding)					
Las Banderas			One day in 5 years	None	None (100% achieved)
Tecolostote			One day in 5 years	None	None (100% achieved)
La Tonga			One day in 5 years	None	None (100% achieved)
(3) Absolute number of accidents					
Las Banderas			2 accidents (2011)	Decreased after the project completion	1 in 2013 7 in 2014 3 in 2015 (Decreased immediately after the Project but increased thereafter)
Tecolostote			3 accidents	Decreased after the project completion	2 in 2013 0 in 2014 1 in 2015 (Decreased after the Project)
La Tonga			9 accidents	Decreased after the project completion	7 in 2013 3 in 2014 9 in 2015 (Decreased after the Project but no clear improvement)
(4) Loss of human life due to bridge collapse					
Las Banderas			—	None	None (100% achieved)
Tecolostote			—	None	None (100% achieved)
La Tonga			—	None	None (100% achieved)

Source: The reference and target values are based on the ex-ante evaluation documents and the report for the Preparatory Study. The actual values are based on the materials provided by MTI. The bridge crossing volume is based on the MTI data plus the results of the traffic volume survey conducted for ex-post evaluation. The number of traffic accidents is based on the data by the Nicaragua police.

- (2) Number of annual occurrences of traffic paralysis (due to flooding): No data on the annual occurrence of traffic paralysis due to flooding was available before the Project and the latest recorded incident was caused by flooding due to Hurricane Mitch. Not a single occurrence of traffic paralysis due to flooding occurred in the three-year period after the completion of the Project.
- (3) Absolute number of traffic accidents: According to Nicaragua police statistics, the absolute number of traffic accidents in 2015 compared to that of the moment of plan, does not have a big change, and according to the annual data since the Project completion, there is no clear tendency. In addition, if the traffic volume of each bridge is taken into consideration, the occurrence rate of traffic accidents can be said to be low. The reasons for traffic accidents (contacts and collisions) cited by the Nicaragua police are failure to maintain an appropriate distance, inappropriate over-taking and road crossing by pedestrians and animals. In short, this means a lack of proper traffic education as well as traffic manners on the part of both drivers and pedestrians. After the completion of the Project, traffic congestion was eliminated, instead, traffic accidents occurred due to a faster travelling speed by vehicles, which highlighted the need for traffic education. It is likely that the number of traffic accidents would be higher if speed reduction zones had not been introduced.
- (4) Loss of human life due to bridge collapse (number of deaths): Because all three bridges do not have any structural problems, and proper maintenance is conducted (for details see “3.5.4 Operation and Maintenance Status”) there is hardly any risk of bridge collapse. It is, therefore, safe to say that the target has been achieved 100%.

In summary, as far as the main indicators are concerned, although the “average travelling speed” has improved, it is limited to certain level due to the introduction of speed reduction zones after Project completion by the government of Nicaragua. In regard to the “elimination of the temporary stoppage of vehicles before the bridge” and “reduction of the river crossing time”, an improvement of more than 80% of the reference value has been achieved. In the case of auxiliary indicators, with the exception of “absolute number of accidents” for which a clear tendency could not be recognized, the other indicators have either achieved the target, or show an improving trend. In summary, the Project is recognized as having contributed to “securing safe and smooth traffic”.

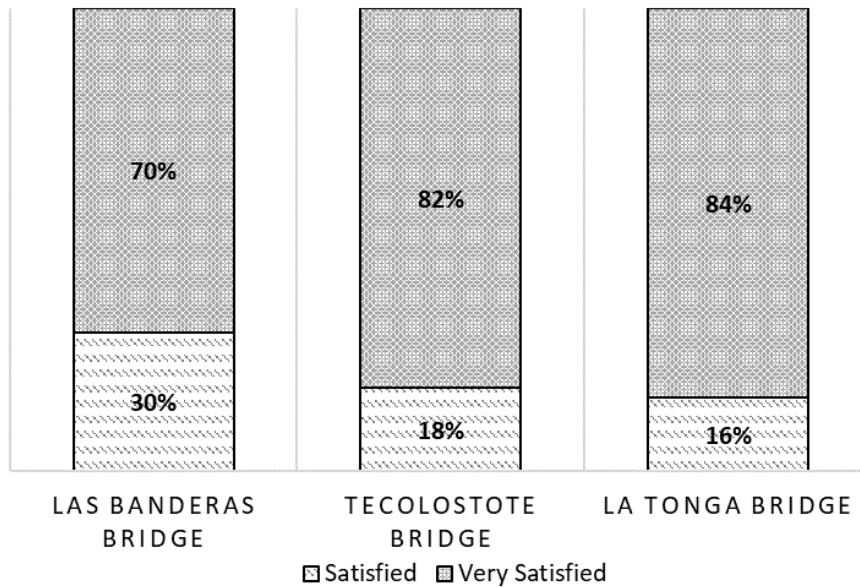
3.3.2 Qualitative Effects (Other Effects)

- (1) Prevention of the collapse of structurally dangerous bridges due to degradation and aging (avoidance of the loss of human life): Although the target bridges had problems of deterioration due to degradation and aging before the Project, none of the bridges had experienced a collapse. In view of the fact that the total of AADT for the three bridges in 2010 was 7,252 vehicles coupled with their heavy use by pedestrians, the Project is believed to have made a major contribution to the avoidance of the loss of human life. In the group interviews with local residents¹⁸, various opinions were expressed, including “the Project has considerably improved the safety of bridge users as there used to be a constant feeling of danger due to degradation and aging and also due to the narrow bridge width and severe wobbling before the Project” and “in the areas where the bridges are located, there are primary and secondary schools, hospitals, etc., and before the Project, it was difficult to go to school or to the hospital from the other bank of the river, but after the Project, safety of pedestrians has been secured”. In sum, the Project is believed to have significantly contributed to improving the living environment of local residents.
- (2) Level of satisfaction of the Project: Although the beneficiary survey (to drivers) found negative opinions such as the fact that the introduction of speed reduction zones has led to increased maintenance need regarding tyres, suspension, etc. and a shorter service life of vehicles, the level of satisfaction with the Project was extremely high based on the overall assessment of the quality, convenience, efficiency, safety, etc. of the bridges. As shown in Fig. 2, satisfaction level was evaluated in four levels, and in all the bridges the evaluation was as high as “satisfactory” or “highly satisfactory”, while “not so satisfactory” or “not satisfactory at all” evaluations were none. Similarly, the interview survey with local residents and logistics service providers¹⁹ found a very high level of satisfaction with the Project. Common requests made in these surveys were the following two: the reinstallation

¹⁸ The details of the group interviews with local residents conducted as part of the ex-post evaluation are: (1) survey period: 21st to 27th February 2017; (2) sample size and gender ratio: 15 for Las Banderas Bridge (Tipitapa City) (7 males and 8 females), 29 for Tecolostote Bridge (San Lorenzo City) (8 males and 21 females) and 18 for La Tonga Bridge (Juigalpa City) (9 males and 9 females); (3) sampling method: a representative resident from the community designated by the municipal government informed local residents beforehand, and those residents who came to the assembly hall on the indicated day and time were interviewed. It is possible that by this sampling method, only those residents with a positive opinion of the Project would be gathered, resulting in a possible bias of the results. However, the objective of the survey was explained beforehand to the municipal government and the representative resident and requests were made to make an effort to conduct a random sampling as much as possible.

¹⁹ Some of the large logistics service providers are members of the Nicaraguan Association of Transporters (NAT). The membership of this association includes 185 companies in possession of more than 50 large vehicles (trucks, buses, tank lorries, etc.), 80 companies in possession of more than 15 vehicles and 1,300 individual transporters in possession of 15 vehicles or less. Meanwhile, many users of the Project are companies (mostly self-employed) belonging to a small association in a local city. For this ex-post evaluation, a representative of the NAT was interviewed to obtain the opinions of large and medium-size companies. An additional interview survey was conducted with a total of 10 associations and self-employed operators based in cities where the target bridges of the Project are located.

of lighting facilities at Las Banderas Bridge and La Tonga Bridge which existed before the Project in order to improve security, and new design of future speed reduction zones to reduce the load on passing vehicles. To sum up, the level of satisfaction among all beneficiaries is high, and the effects of the Project can be recognized.



Source: Results of the Beneficiary Survey

N=150

Fig. 2 Level of Satisfaction with the Project: Drivers

3.4 Impacts

3.4.1 Intended Impacts

The assumed impacts of the Project were (1) promotion of the local economy along the route and (2) vitalization of domestic and international logistics. For this ex-post evaluation, a beneficiary survey with drivers, group interviews with local residents and an interview survey with logistics service providers were conducted and the impacts of the Project were analysed based on the results of these surveys.

- (1) Promotion of the local economy along the route: As shown in Table 5, it is clear that the Project has contributed to the vitalization of the economy and improvement of the living conditions for local residents along National Highway No. 7. In cities where the subject bridges are located, local industries have been vitalized due to fresh investment and expansion as a result of the Project. Local residents believe that their options have increased due to the availability of much more merchandise and that the increase of

commercial establishments has made life more convenient. In short, the Project is believed to have significantly contributed to “the promotion of the local economy along the route”.

Table 5 Impact: Promotion of Local Economy Along the Route

Survey Subjects	Results
Drivers (150)	<ul style="list-style-type: none"> • 90% of the respondents replied that “the Project has contributed to economic vitalization along National Highway No. 7 between Managua and El Rama”. • 94% replied that “the Project has contributed to improvement of the living conditions of residents in cities located between Managua and El Rama.
Local residents/logistics service providers	<ul style="list-style-type: none"> • <u>Common opinions concerning the three bridges</u>: Many businesses have opened along National Highway No. 7 such as restaurants, petrol stations, large supermarkets, pharmacies and tourist shops. The price range of daily commodities has widened, providing more options for local residents. However, the prices of some goods have either increased or decreased due to an increased demand and it cannot be said that prices in general have stabilized. Although the effects on rectification of the poverty gap are not yet visible, further progress of the ongoing vitalization of the local economy might narrow the poverty gap in the medium to long-term. • <u>Las Banderas Bridge</u>: As far as quarrying, which is a local industry, is concerned, 8 medium-size domestic and foreign companies have commenced local operation since the completion of the Project, boosting local employment. Local residents employed by these companies now enjoy a stable income and health insurance. • <u>Tecolostote Bridge</u>: The leading industries in the city of San Lorenzo are agriculture (Altamira, the largest rice producer in Nicaragua is based in the city), animal husbandry and quarrying. The implementation of the Project has improved the efficiency of logistics for these industries. Along with a population increase, the local economy has certainly been vitalized. • <u>La Tonga Bridge</u>: In addition to the vitalization of local industries (agriculture and animal husbandry), the San Antonio District located on the El Rama side of the bridge has much developed with the opening of a large supermarket, bank, clinic, large hardware store, large warehouse of a multi-national beverage company, tourist shops, etc. compared to time before the Project when only a petrol station was located there. Following this development, the land price has increased to US\$ 120 per 1 “bara” (0.70 ha) at the time of ex-post evaluation from US\$ 80 per 1 “bara” for land along National Highway No. 7.

Source: Results of the beneficiary survey, group interviews and other interviews conducted by the evaluator.

(2) Vitalization of domestic and international logistics: The traffic survey conducted for this ex-post evaluation found that Managua is the main departure point for drivers using the Project-related bridges and the main destination is Juigalpa, followed by El Rama. At present, National Highway No. 7 is the only road linking Managua and El Rama and it is safe to assume that National Highway No. 7 on which the three bridges of the Project are located accounts for most of the logistics between Managua and El Rama. Drivers and logistics service providers have expressed their shared opinion that the Project has greatly contributed to the vitalization of domestic logistics (Table 6). Meanwhile, the cargo handling volume at the port of Arlen Siu, which plays a role in international logistics in Nicaragua in the city of El Rama, increased from 32,000 tons in 2010 to 48,000 tons in 2015. From the interviews to logistics service providers it was found that the improvement of National Highway No. 7 including the Project, has made international cargo logistics on the Atlantic side more efficient, stimulating up to some extent the corresponding operations.

A further contribution by the Project to the vitalization of international logistics can be expected with the progress of improvement of National Highway No. 7 and vitalization of the local economy along the route.²⁰

Table 6 Impacts: Vitalization of Domestic and International Logistics

Survey Subjects	Results
Drivers (150)	<ul style="list-style-type: none"> • 84% replied that “the Project has contributed to the logistics of local industries”. • 83% replied that “the Project has contributed to the logistics of the Eastern Region and international logistics”.
Logistics service providers	<ul style="list-style-type: none"> • The Project has made the use of National Highway No. 7 safer and more efficient. As the current use of this road is mainly dominated by domestic logistics, the Project has made a considerable contribution to the vitalization of domestic logistics. To be more precise, the overall bridge crossing time has been reduced from 3-4 hours to a maximum of five minutes and, consequently, the travelling time between Managua and El Rama has been shortened from 8 hours before the Project to 6 hours. As a result, the occurrence of late deliveries has become less frequent, petrol consumption has been reduced, damage to animals and cargo has decreased significantly and the quality of merchandise has been secured. Logistics service providers have brought future access to Costa Rican markets with the opening of Santa Fe Bridge, etc. into their perspective and are hoping for the vitalization of such international logistics. • The introduction of speed reduction zones has increased the load on passing vehicles and the cost of replacing parts has increased by an average of some 30% compared to the pre-project period. However, the overall profit has increased due to an increased turnover and reduction of the fuel cost.²¹

Source: Results of the beneficiary survey, group interviews and other interviews conducted by the evaluator.

As described above, domestic logistics are the main logistical operation over the three bridges of the Project at the time of ex-post evaluation, but the vitalization of international logistics can be expected due to the utilization of the port of Arlen Siu and the further improvement of National Highway No. 7. As such, a sufficient impact is recognized in relation to “the vitalization of safe and smooth domestic and international logistics”.

3.4.2 Other Positive and Negative Impacts

(1) Impact on the natural environment

For the Project, an “environmental management and monitoring plan” which is simpler than an environmental impact assessment was implemented based on the judgement made by

²⁰ The vitalization of international logistics by the Project is expected to be further enhanced with the commencement of international logistics between Nicaragua and Costa Rica through the Santa Fe Bridge located on the Atlantic Corridor (under JICA’s grant aid “Project for Construction of Santa Fe Bridge in the Republic of Nicaragua” (2010) which has a complementary relationship with the Project, as well as with the further improvement of National Highway No. 7 planned by other donors.

²¹ The interview with the Nicaraguan Association of Transporters found that the total volume of cargo transportation between Managua and El Rama increased from 2,000 tons/day before the Project to some 6,000 tons/day at the time of ex-post evaluation. The main cargoes from Managua to El Rama are sugar, iron, cement, processed food and grain while those from El Rama to Managua are vegetables, dairy products, domestic animals, construction materials and palm oil.

the Ministry of the Environment and Natural Resources (MARENA). The MARENA notified the MTI to obtain an environmental permit from those municipalities in which the bridges in question were located. This permit was obtained on June 25, 2010 for Las Banderas Bridge, June 29, 2010 for Tecolostote Bridge, and July 12, 2010 for La Tonga Bridge.²² The excavation permit for the borrow pit and permit for the felling of trees were obtained for the Project in November 2010 from MARENA and the National Forestry Institute (INAFOR) respectively. For the implementation of environmental measures and environmental monitoring during the project implementation period, regular monitoring of the implementation status of the “environmental management and monitoring plan” was conducted with the attendance of representatives of the MARENA, municipal governments, MTI and contractor and instructions were issued when necessary.²³ In connection with the felling of trees, 200 seedlings were planted at Tecolostote Bridge as officially promised to the Tecolostote Secondary School. At La Tonga Bridge, 550 seedlings were planted as planned.²⁴ Prior to the completion of the Project, final inspection by MARENA took place in February 2013 and the completion of the environmental management and monitoring plan was confirmed and approved in August of the same year. Based on these results, it was possible to confirm that the impact of the Project on the natural environment was kept to a minimum.

(2) Resettlement and land acquisition

Relocation of businesses which illegally occupied the construction sites and also the acquisition of land resulted from the Project. These were completed in accordance with the relevant domestic procedures in Nicaragua in April 2011 prior to the commencement of the tender for the Project. The planned and actual performance are shown below.

²² The initial environmental assessment was conducted in September 2009 and registration with the National Public Investment System (Sistema Nacional de Inversión Pública) was completed in January 2011.

²³ During the construction work, several environmental measures were implemented: (i) as for dust and emissions, regular water spraying of the road and work site (especially the crusher) and periodic maintenance of vehicles was conducted thoroughly, (ii) as for noise and vibration, a low noise, low vibration construction method was adopted (use of a noise suppresser, etc.) to control noise and vibration in addition to the avoidance of school hours for the work in the case of Tecolostote Bridge located near a school and (iii) as for sewage (adverse impact on the river) portable toilets were installed to discharge treated sewage through a sewer. In order to prevent impact on rivers due to landslides etc., at the moment of construction works, necessary filling up of land and forestation were conducted in advance. In the beneficiary survey, 79% of the respondents said that “there was no socioeconomic or environmental impact during the construction work under the Project”, while 15% said that “there were some impacts”, and 6% did not answer. None of those who responded that “there were some impacts” placed any claims or demanded mitigation measures to the municipal government, as they considered that these impacts were within bearable limits. In the interviews to local residents, even though some also pointed out the occurrence of dust, they considered that they were within the allowable range, and most of them expressed a positive opinion of the safety measures, etc. introduced.

²⁴ At the Las Banderas bridge site, 36 trees were felled. However, the survey conducted by the MARENA and INAFOR found that these trees were already in the process of dying and concluded that replacement planting was not required.

Table 7 Resettlement and Land Acquisition*: Planned and Actual

Bridge	Planned	Actual
Las Banderas Bridge	<ul style="list-style-type: none"> • Resettlement: A total of three general stores and cafes illegally occupying the site were required to relocate along with one shed and one rain gauge station. • Land acquisition: Not required 	<ul style="list-style-type: none"> • Resettlement: Three commercial premises and one shed which illegally occupied the site were relocated to land provided by the municipal government. The rain gauge station was relocated in March 2011 by the National Land Agency. • Land acquisition: None
Tecolostote Bridge	<ul style="list-style-type: none"> • Resettlement: Not required • Land acquisition: Right bank downstream: 1,170 m², left bank downstream: 1,490 m² 	<ul style="list-style-type: none"> • Resettlement: 8 households which partially occupied the planned construction site illegally, withdrew from their illegally occupied areas for which compensation was paid based on the results of assessment by the assessor as indicated by the laws in Nicaragua. • Land acquisition: Conducted as planned. Compensation was paid to the landowner (one owner) after negotiations witnessed by the municipal government.
La Tonga Bridge	<ul style="list-style-type: none"> • Resettlement: Not required • Land acquisition: Right bank downstream: 900 m², left bank downstream: 2,715 m² 	<ul style="list-style-type: none"> • Resettlement: One household partially occupying the planned construction site illegally, withdrew from the illegally occupied area for which compensation was paid based on the assessment results of the assessor as indicated by the laws in Nicaragua. Seven commercial premises with occupied the planned construction site were relocated. • Land acquisition: Conducted as planned. Compensation was paid to the landowner (one owner) after negotiations witnessed by the municipal government.

Source: Preparatory Study Report for the planned, and documents provided by MTI for the actual.

*: Land under land acquisition, was land acquired from formal owners such as private persons or companies, and no illegally occupied land are included.

Regarding land acquisition, direct negotiations were conducted between the executing agency and the owners, however, regarding resettlement, meetings between the executing agency, the municipal governments where each of the bridges are located, and residents were held in 2011. Based on the contents agreed in the meetings, resettlement was completed without any delay. The resettlement of residents that were illegally occupying national or municipal land, a compensation to move was paid based on the evaluation results of an assessor in accordance with the laws of Nicaragua. As the sites for land acquisition were not used for any productive activity or for dwelling purposes, no socioeconomic or environmental impact occurred.

(3) Other impacts

There was one secondary impact which was not assumed at the time of project planning, which is the discontent indicated by the Tecolostote Secondary School to the fact that there are some items not yet conducted in spite of a formal agreement was signed between the executing agency and the school. As described in “3.2.1 Project Outputs”, the construction of an access road to Tecolostote Bridge necessitated the moving of the boundary of Tecolostote Secondary School located at the side of the bridge. It subsequently became known that there was an agreement between the school and the MTI to conduct reforestation on the school premises, construction of perimeter fencing among other things. The site visit as part of the ex-post evaluation confirmed that most of the work was completed and that the intended reconstruction was properly carried out. However, classrooms (2 rooms) and the security station are yet to be constructed and the school has indicated their discontent to the fact that in spite of the agreement made in order to enable the construction of the bridge, the contents of the agreement have not been completely conducted as agreed. The MTI is currently arranging an assessment of the situation, and a meeting with the school as a first step with a view to including any necessary work in the FY 2018 budget.

From the above, the Project has largely achieved its objectives and, therefore, its effectiveness and impact are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

The supreme body responsible for the planning and monitoring of road infrastructure maintenance in Nicaragua is the General Direction of Terrestrial Transportation (GDTT) of the MTI. At the time of the ex-post evaluation, the MTI has 1,117 staff members of which 284 belong to the GDTT where two engineers supervise the maintenance of bridges. MTI does not conduct maintenance of road and bridges directly, as it is a supervisory entity.

The actual maintenance work is entrusted to the Road Maintenance Fund (Fondo de Mantenimiento Vial: FOMAV) which is an autonomous entity although it conducts these works in cooperation with MTI, and the Corporation of Regional Construction Companies (Corporación de Empresas Regionales de la Construcción: CORECO). The daily and periodic preventive maintenance (initial repair of paving, cleaning of side ditches, repair of paved surfaces, installation of traffic signs and relocation/installation of bus stop signs etc.), of roads and bridges that are classified as relatively “good” or “normal” state based on the evaluation standards of MTI, are conducted by FOMAV, whereas the repair and maintenance of roads and bridges in bad shape and require large repairs are conducted by COERCO.

As an autonomous entity, FOMAV signs an annual agreement with the MTI and conducts the above mentioned routine maintenance and periodic maintenance. For the Project, FOMAV is in charge of the routine maintenance and periodic maintenance of bridges and access roads. FOMAV employs some 50 staff members (three engineers are directly involved in the maintenance of the bridges of the Project). FOMAV enters into a road maintenance contract with micro companies²⁵ formed by local residents for each



FOMAV workers conducting cleaning work near Tecolostote Bridge

road section and monitors their maintenance work on a monthly basis. In FY 2016, such a contract was signed with 54 micro companies (with a total of 846 employees). As each road section maintained by a micro company is located in the area where the staff members of the company live, the ownership level on the part of the company is relatively high. The good state of the bridges and access roads maintained by the micro companies was confirmed during on-site visits conducted during the filed survey. The results of interviews with local residents and the beneficiary survey also show a high level of appreciation and satisfaction with the frequency and contents of the bridge and access road cleaning conducted by these micro companies. FOMAV's institutional organization, chain of command, contracts with micro companies, administration and monitoring procedures are also clear.

Meanwhile, CORECO was established in 1988 under the jurisdiction of the MTI. It has four regional offices and the bridges of the Project are managed by COERCO-EICMEP Manuel Escobar Pereira Integral Construction Enterprise (COERCO-EICMEP) based in the southeastern part of Managua Department. COERCO-EICMEP employs some 400 people (of which one engineer and nine workers are directly involved in the maintenance of the three bridges of the Project) and has some 105 units of maintenance equipment. It is in charge of relatively large-scale maintenance of the three bridges of the Project. The organizational structure and command system of COERCO are also clearly defined.

As described above, the existence of a comprehensive system to ensure the implementation of maintenance work without fail has been confirmed by this ex-post evaluation as all of the MTI, FOMAV and COERCO have a clear organizational system, command system and division of work regarding the maintenance of the Project.

²⁵ The method through which FOMAV employs micro companies as an entity in charge of the routine and period maintenance of roads was introduced in 1997 by a World Bank program. A micro company consists of at least 12 local residents, and it is contributing to the creation of employment of each region's poverty population and to gender equality (10% of the total 846 members are women). This method is highly acclaimed by the local residents, and the number of kilometres of road that where routine and periodic maintenance are conducted is increasing steadily, producing high results (Source: documents provided by FOMAV).

3.5.2 Technical Aspects of Operation and Maintenance

At the time of ex-post evaluation, none of the MTI, FOMAV or COERCO have an institutionalized human resources development system except for sporadic irregular training sponsored by a donor or using the MTI budget as listed below.

- Training by MTI: The only training related to bridges in FY 2017 by MTI, which was secured at the time of ex-post evaluation, features “Fundamentals of Bridge Structure” (total period: 8 months) and the participants include Project-related personnel of which 18 are from the MTI, two from the FOMAV and five from COERCO-EICMEP. Both the FOMAV and COERCO conduct irregular training on maintenance-related equipment as required. However, such training is not based on an officially established training schedule. All three organizations list “bridge inspection”, “structural assessment of bridges” and “bridge maintenance methods using new technologies” as the most desirable areas for human resources development and consolidation in the coming years.
- Technical assistance and training by other donors: The training provided by donors ranges from that focusing on the strengthening of operation to that featuring maintenance techniques. At the time of ex-post evaluation, there are eight ongoing or planned training schemes on operation and maintenance systems and techniques sponsored by the World Bank, IDB, etc. The Nordic Development Fund (hereinafter referred to as “NDF”) has implemented a long-term technical cooperation project entitled “Road Sector Support Program: Developing Adaptive Capacity for Climate Change” from 2012 to 2017. Other assistance are short-term training sessions, etc., all of which are contributing to the strengthening of the operation and maintenance system and technical capability of the MTI.

With respect to the maintenance manual, the Road Maintenance Manual of the Secretariat for Central American Economic Integration (hereinafter referred to as Secretaría de Integración Económica Centroamericana: SIECA) is used as a road maintenance manual for the checking of roads in Nicaragua. For bridge maintenance, the “General Specifications for the Construction of Roads and Bridges NIC-2000” is used. It must be noted that while the latter specifies the manpower strength and equipment required to be used for maintenance, it does not specify the work frequency. As such, the general understanding is that it is desirable to implement maintenance work as proposed in the Preparatory Study Report (2010) (Table 8). Daily maintenance and regular inspection are conducted by FOMAV and COERCO and workers visually inspect the bridge conditions, determine the priority ranking of the maintenance needs and conduct the actual work in accordance with the required frequency based on the ranking. There are no major problems in regard to the technical level of maintenance workers.

In summary, there are no major problems with the technical aspects of operation and maintenance of the Project because the maintenance work to be conducted by the FOMAV does not require high level techniques or expertise. However, none of the MTI, FOMAV or COERCO have an established training plan or human resources development system or qualification system. It is, therefore, desirable that they establish a human resources development system, secure an annual training budget and conduct these systematically.

3.5.3 Financial Aspects of Operation and Maintenance

A) MTI: At the time of ex-post evaluation, contrary to the overall increasing trend of the MTI budget, the budget for the large-scale maintenance of roads and bridges has shown a declining trend. The reason for this is the declining need for large-scale repair in line with the improvement of the national road network (including bridges). The defect inspection conducted in 2014 in relation to the Project pointed out that “The funding shortage to deal with emergencies and large-scale repair was dealt with by loans from the IDB and Central American Bank for Economic Integration (CABEI) and carrying-over to the following fiscal year occurs frequently. As there is not a proper fund procurement plan to meet the estimated essential maintenance cost, improvement of this situation is required.” This situation had not improved by the time of the ex-post evaluation. But a procedure through which MTI can make a special budget application to the Ministry of Finance and Public Credit (MHCP) is clearly established as a system to deal with emergencies.

Table 8 Proportion of Road and Bridge Maintenance Budget in the MTI Budget

(Unit: million Cordoba)

	2010	2014	2015	2016
Budget	2,622	3,883	4,470	6,023
Road Maintenance Budget (Bridges Included)	303	338	206	168
Proportion to the Budget of the Ministry	11.6%	8.7%	4.6%	2.8%

Source: MTI

B) FOMAV: If proper routine and periodic maintenance is conducted, the Project’s service life is 50 years, thus it is highly important for FOMAV to secure the necessary budget. The budget for FOMAV principally relies on the fuel tax imposed on petrol, gas oil, etc. and US\$ 0.16/gallon (as of 2016) is allocated to FOMAV’s budget. As shown below, FOMAV has operated in the black for the last three years, and in view of the fact that the annual maintenance cost for the bridges and access roads of the Project for which FOMAV is responsible is 710,000 Cordoba, which accounts for a mere 0.4% of the total profit in FY 2015, it can be said that FOMAV is in position to properly conduct routine and periodic maintenance.

Table 9 Income and Expenditure of the FOMAV

(Unit: million Cordoba)

		2014	2015	2016
Income	IEFOMAV*	1,028	1,207	1,211
	IDB, World Bank	18	26	25
	Other	221	170	213
	Sub-Total	1,267	1,403	1,449
Expenditure	Management and Personnel	18	12	13
	Administration and Finance Bureau	16	15	13
	Procurement Bureau	4	3	3
	Technical Bureau (Maintenance)	19	17	17
	Sub-Total	57	47	46
Operating Profit		1,210	1,356	1,403
Other Expenditures and Project Cost		962	1,189	773
Profit		246	167	630

Source: MTI and FOMAV. Up to November for 2016

* IEFOMAV: Income from fuel tax allocated to FOMAV

C) COERCO-EICMEP: The annual maintenance cost of the three bridges (bridge structure) of the Project for COERCO-EICMEP is 480,000 Cordoba which was equivalent to some 16% of the income in FY 2015. In principle, COERCO-EICMEP receives its annual budget from the MTI based on the annual road and bridge maintenance plan and no major financial problems are envisaged in the near future.

Table 10 Income and Expenditure of the COERCO

(Unit: million Cordoba)

		2014	2015
Income	Road Maintenance	288	297
	Other Services, etc.	8	9
	Sub-Total	296	306
Expenditure	Road Maintenance	221	237
	Other Equipment Maintenance	50	50
	Management Cost	16	16
	Sub-Total	287	303
Operating Profit		10	3
Other Expenditure		(2)	(1)
Profit		8	2

Source: COERCO

In summary, while further improvement is necessary for the MTI to secure the budget for emergency repair work, the financial state of FOMAV which conducts the routine and periodic maintenance as well as that of COERCO-EICMEP which is responsible for the maintenance of the bridge structure is enough to fully meet the necessary maintenance cost.

3.5.4 Current Status of Operation and Maintenance^{26 · 27}

The state of the maintenance of all three bridges is good, partly because they are still only three years old and partly because of the adequate routine and periodic maintenance by the FOMAV and COERCO-EICMEP. As shown in Table 11, the inspection frequency does not necessarily meet what is proposed in the Preparatory Study Report, but the current maintenance method has not caused any major problems by the time of the ex-post evaluation.

Table 11 Contents and Frequency of Maintenance Work Proposed in the Preparatory Study Report and Actual Performance by the Responsible Organizations

	Proposed Contents and Frequency of Maintenance Work	FOMAV Actual Performance	COERCO-EICMEP Actual Performance
Routine maintenance	Maintenance of side ditches, paving, expansion joints and shoulders and cleaning of the bridge: 4 times/year for 2 days each time	<ul style="list-style-type: none"> • Cleaning of traffic signs and access roads: twice/year • Cleaning of shoulders, side ditches and pavements and weeding: 4 times/year for 2 days each time • Painting of handrails of the pavement: once/year • Relocation/erection of road traffic signs and bus stop signs: as needed 	Not responsible
Periodic inspection	Periodic inspection of the bridge and access roads (cracking, uneven surface, defects, etc.): 12 times/year for 1 day each	<ul style="list-style-type: none"> • Periodic inspection of the access roads: 12 times/year 	The concrete maintenance conducted between project completion and ex-post evaluation includes pressure cleaning of the bridges, repainting and maintenance of the road markings and road signs at irregular intervals.
Repair	Repair of the paving, side ditches, body, bridge facilities, shoulders and slopes: once/year for 4 days	Not responsible	Because of the relatively short time since commencement of the usage of the bridges and because of the generally adequate routine and periodic maintenance, no need for repair has arisen up to the ex-post evaluation.

Source: The micro companies entrusted to conduct the routine maintenance of the bridges and inspection of the access roads are required to submit a monthly maintenance report to FOMAV. Similarly, COERCO-EICMEP prepares a monthly maintenance record and submits it to MTI. The contents of this table are based on the reports prepared by these micro companies (cooperatives) for 2013 to 2016 and reports submitted by COERCO-EICMEP.


²⁶ For evaluation of the maintenance conditions at the three bridges as part of the ex-poste valuation, the Central American Manual for Risk Management of Bridges 2010 (Manual Centroamericano de Gestión del Riesgo en Puentes, 2010) was used.

²⁷ In the Reports for the Basic Design Study, Preparatory Study and Defect Inspection, the Consultant made four recommendations/proposals ((1) repair and reinforcement of the existing Tecolostote Bridge, (2) demolition and removal of the existing La Tonga Bridge, (3) rehabilitation of a bus stop shelter at Las Banderas Bridge and Tecolostote Bridge and (4) repair and reinforcement of the existing Cuisalá Bridge) to the MTI. The completion of all of these recommendations/proposals by the time of the ex-post evaluation has been confirmed by the evaluator.

The field visit for the ex-post evaluation did not find either any blocked side ditches of the access roads with rubbish or any damage of the various facilities mentioned by the Report for Defect Inspection in 2014. Las Banderas Bridge and Tecolostote Bridge are steel truss bridges that use atmospheric corrosion resistant steel²⁸, and they were already painted with a special high-resistance paint at the time they were installed. However, at the moment of the ex-post evaluation, the said paint was out of stock and there was no information on where to buy it, and this fact was pointed out by the executing agency as a shortcoming.²⁹ As for other materials and its spare parts that are necessary for maintenance, no special problems were found through interviews to FOMAV and COERCO, as well as on-site visits.

The state of maintenance at the time of ex-post evaluation and points for desirable future improvement are listed below.

Table 12 State of Maintenance at the Time of Ex-Post Evaluation and Points for Future Improvement

State of Maintenance and Points for Future Improvement	
【Las Banderas Bridge】	
	<ul style="list-style-type: none"> • Generally in good condition. • Rust is observed in the steel girders, mounting members, nuts and bolts of the superstructure. After analysing the rust, if it is rust caused by corrosion, it is necessary to clean any dirt, maintain a dry condition, and take necessary measures to prevent further corrosion by procuring the special paint from Guatemala*. Some of the hydraulic cylinders connecting the superstructure and substructure have bird droppings stuck to the neoprene cover. These droppings should be removed during periodic maintenance.
<ul style="list-style-type: none"> • Surface cracks are observed with the paving near the joints between the bridge and access road. While urgent repair is not required, it is desirable for the work to be included in the scope of periodic maintenance. • The superstructure of the bridge when going from Managua to La Tonga has graffiti done with a sharp blade as well as with paint. Special paint should be procured from Guatemala to repair the area to prevent any corrosion from these graffiti. 	

²⁸ Atmospheric corrosion resistant steel is a steel that forms a layer of fine “protective rust” in its surface when exposed repetitively to an adequate humidity in the air (Source: Japan Iron and Steel Federation). Normally it is used without applying any paint, however, taking into consideration its appearance, in the Project a special paint was applied beforehand and then installed. The said special paint is a resin paint that is used to stabilize the rust of the atmospheric corrosion resistant steel. It has the effect of controlling rusting at its initial stage, preventing rust to expand to the surrounding area.

²⁹ However, after the first field visit, provision of information by the consultant speeded up, and MTI had received information that this special paint could be procured in Guatemala.

- It is necessary to install lighting which existed before the Project for night-time security.

【Tecolostote Bridge】



- Generally in good condition.
- Superstructure: rust is observed with the vertical and horizontal girders, diagonal and mounting members, nuts and bolts. After analysing the rust, if it is rust caused by corrosion, it is necessary to clean any dirt, maintain a dry condition, and take necessary measures to prevent further corrosion by procuring the special paint from Guatemala*.
- As many drivers appear to urinate towards the steel abutment, erosion in this area is advancing more rapidly compared to that of other areas. As there is also bad smell, it is necessary to adopt certain measures, including regular cleaning and the installation of a signs.
- Surface cracks of the paving near the joints between the bridge and access roads are observed. While urgent repair is not required, it is desirable for the work to be included in the scope of periodic maintenance as necessary.

【La Tonga Bridge】



- Generally in good condition.
- Because of the absence of a steel structure in both the superstructure and substructure, the problem of rust does not occur thus the condition of the bridge is good.
- Many drivers appear to urinate at the concrete pier. In addition to regular cleaning, some measures, including the installation of signs, should be taken.
- It is necessary to install lighting which existed before the Project for night-time security.

* For Las Banderas Bridge and Tecolostote Bridge, the Report for Defect Inspection in 2014 already pointed out that “Although the two newly constructed bridges are steel girder bridges using atmospheric corrosion resistant steel, the good quality of the members cannot be maintained if they are in a wet condition for a long period of time. Therefore, it is necessary to clean rubbish and dirt stuck to the steel members during periodic maintenance to keep them dry.” (Report for Defect Inspection, 2014).

Based on the above, it was possible to confirm that the maintenance status of the bridges of the Project are generally good. In order to prevent further corrosion caused by graffiti in Las Banderas Bridge, it is desirable to procure the special paint from Guatemala and take necessary measures. As for the rust seen in Las Banderas Bridge and Tecolostote Bridge, once an analysis of the rust is conducted, it is desirable to consider and implement necessary measures.

From the above, no major problems have been observed in the institutional, technical and financial aspects and current status of the operation and maintenance. Therefore, the sustainability of the project effects is high.

4. Conclusion, Recommendations and Lessons Learned

4.1 Conclusion

The Project was implemented for the purpose of securing safe and smooth traffic between Managua and El Rama on National Highway No. 7 which is an international trunk road passing through Nicaragua by means of rebuilding three bridges, thereby contributing to the vitalization of domestic and international logistics and also to the promotion of the local economy along the route. At the time of both planning and ex-post evaluation, the Project is fully consistent with the national development policies, the transport sector policies and development needs of Nicaragua and with Japan's ODA policies and, therefore, its relevance is high. The outputs are generally as planned, and both the total project cost and project period were within the plan, thus the efficiency of the Project is high. The assumed effects of the Project, namely, traffic congestion before the bridge, and time for cars to cross the bridge improved significantly. On the other hand, although considerable improvements can be recognized for the temporal stoppage before entering the bridge as well as the average travelling speed on the bridge, these have not been fully eliminated as originally planned, because speed reduction zones were introduced by the Nicaraguan government after the completion of the Project in order to ensure the safety of local residents crossing the road. In addition, the risk of bridge collapsing due to aging has been eliminated. The assumed impacts on the promotion of the local economy along the route and vitalization of domestic and international logistics are confirmed. As the implementation of the Project has generally produced the planned effects, the effectiveness and impacts of the Project are high. The institutional, technical and financial aspects of the entities that are in charge of the Project's operation and maintenance, that is the MTI, FOMAV and COERCO, as well as the current status of operation and maintenance of the Project are generally good and the sustainability of the effects of the Project is high.

In line of the above, the Project is highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations for the Executing Agency

- It is desirable for MTI to supervise the proper implementation of maintenance-related issues to be carried out by FOMAV which are listed in Table 12 "State of Maintenance and Points for Future Improvement". Especially regarding the rust seen in Las Banderas Bridge and Tecolostote Bridge, once an analysis of the rust is conducted, it is desirable to consider and implement necessary measures. As for the prevention of corrosion due to graffiti in Las Banderas Bridge, since there is a risk of further corrosion from these parts, it is desirable to incorporate the budget for the procurement of this special paint from Guatemala in the FY 2018 budget at the latest.

- MTI and FOMAV should consider the introduction of lighting for Las Banderas Bridge and La Tonga Bridge to strengthen traffic as well as pedestrian safety. It is desirable for the necessary funding to be incorporated in the FY 2018 budget at the latest to urgently deal with this matter.
- As already recommended by the Report for Defect Inspection, there is no proper procurement plan in place to meet the estimated cost of dealing with emergencies and large-scale repair work. Even though an application procedure for a special budget exists, because Nicaragua is a country especially with a lot of natural disasters such as hurricanes, MTI is indicating its interest to proceed with the preparations so that in two years' time it can secure the relevant budget. As a first step, it is desirable to estimate the said cost in advance.
- According to the Nicaraguan police, traffic accidents are a leading cause of death in the country and constitute a serious social problem. In connection with the Project, speed reduction zones were introduced to reduce the travelling speed at the bridges following a fatal accident which occurred approximately one year after project completion. The MTI should strengthen traffic education so that the expected effects of the improved road infrastructure can be fully achieved, and the safe use of roads and bridges can be secured. To be more precise, the MTI should urgently invite the cooperation of the Ministry of Education, Police, municipal governments, NGOs, and research institutions to implement the 14 actions listed in the *"Five Year Action Plan for Road Traffic Safety"* proposed by the *"Road Traffic Safety Program"* of the *"National Transport Plan for Nicaragua"* which is referred to in "3.1.1 Relevance: Consistency with the National Development Policies" so that continuous transport education designed to improve and reform the traffic safety awareness of the Nicaraguan people can be enhanced and thoroughly implemented.

4.2.2 Recommendations for JICA

It is desirable for JICA to periodically monitor the implementation situation of the maintenance work recommended in Sustainability (Table 12: State of Maintenance and Points for Future Improvement), and to provide the necessary advice in order to secure the sustainability of the project effects.

4.3 Lessons Learned

Verification of the role of the bridge for the nearby community, and setting the target values for the effect indicators at the time of planning

In the Project, the target values for the effect indicators were set based on the standards for an international trunk road as the focus of the Project was to make the bridges perform their

functions as part of such a trunk road. However, due to the accident that occurred after Project completion, speed reduction zones were installed on both sides of each bridge. Because of this, one principal effect indicator could not achieve 80% of the target value. In Nicaragua, the legal speed limit for a national highway such as the one where the Project is located is 80 km/hour. However, when a bridge is located in a mid-size city such as Tipitapa, San Lorenzo or Juigalpa which expand to both sides of National Highway No. 7, as well as on both sides of the respective rivers, as in the case of the Project, the bridge is used not only by vehicles but also by pedestrians. Especially local residents routinely cross both the bridge and the national highway many times a day, which have become part of their lives. As the existence of a local community near each bridge and inadequate traffic manners were known at the time of planning, the planning of the Project in general and setting of indicators in particular should have taken them into consideration. For a similar project in the future, it is desirable to check (1) the existence of a community near the target bridge, and (2) the entrenchment of a culture among drivers and local residents to adhere to traffic manners. When a bridge and national highway on which a bridge is located form an integral part of the local life, advance consultation with the implementing agency should be held with a view to incorporating such items in the project plan as a pedestrian bridge, or speed reduction zones with a design which minimizes adverse impact on the vehicles. At the same time, it is desirable to discuss with the executing agency awareness-rising measures to be incorporated in the Project that point to the strengthening and thorough implementation of traffic safety and traffic manner education.

Assessment on possible procurement and selection of necessary paint, equipment and its spare parts for bridge maintenance in the domestic or regional market at the time of planning

The paint used in the Project was a highly durable paint designed to minimize the routine maintenance requirements and prevent corrosion. It was later found that this paint cannot be procured in the inside Nicaragua. At the time of ex-post evaluation, there was no stock of this paint, making maintenance work to prevent corrosion impossible especially at the Las Banderas Bridge that have graffiti by both paint and by a sharp object. During the ex-post evaluation, it was confirmed that the same special paint could be procured in Guatemala, however, for similar projects, it is essential to confirm the availability of any necessary paint and spare parts for equipment for bridge maintenance in the domestic market or regional market and to provide this information with the executing agency to secure the sustainability of the project effects.

END