

0. Summary

“The Project for Construction of Paso Real Bridge” (hereinafter referred to as “the Project”) was implemented with the aim of achieving safe and smooth river-crossing traffic over Matagalpa River on National Route 21 by replacing the existing Paso Real Bridge (temporary bridge) located in Matagalpa Department of Nicaragua with a permanent one, thereby contributing to the facilitation of the smooth flow of goods. At the time of both planning and ex-post evaluation, the Project is highly consistent with the development policy/plan and development needs of Nicaragua. As the Project is also consistent with Japan’s assistance policy for Nicaragua at the time of appraisal, the relevance of the Project is high. The outputs of the Project are as planned with both the project cost and project period being within the planned ranges. Therefore, the efficiency of the Project is high. Since the implementation of the Project, there has been no traffic suspensions due to an increased river water level or other reasons at Paso Real Bridge, and the river-crossing time has been shortened. Moreover, the danger posed by over-loaded vehicles above the weight limit crossing the bridge and the number of traffic accidents on the bridge have been reduced. Apart from the fact that the speed limit is not totally adhered to, the purpose of the Project to realize safe and smooth river-crossing traffic has been achieved. The overall traffic volume has recorded an increasing trend, indicating certain positive socioeconomic impacts due to the facilitation and smoothing of physical distribution. Based on the above, the effectiveness and impact of the Project are high. No major problems have been observed in the institutional/organizational, technical and financial aspects of the operation and maintenance of the Project and, therefore, the sustainability of the effects realized by the Project is high.

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

1. Project Description



Project Location



Paso Real Bridge

1.1 Background

In the transportation sector of Nicaragua, land transportation accounts for some 70% of physical distribution and almost 100% of personnel transportation. Under the Ortega administration which began its second term in 2012, the Ministry of Transport and Infrastructure (MTI) was earnestly engaged in the improvement of trunk roads leading to the Caribbean side of the country with a large proportion of poor people for the purpose of reducing income disparity through the building up of the trunk road transportation network. National Route 21 (NR-21) is the only trunk road leading to the North Caribbean Coast Autonomous Region (RACCN) and plays the important role of securing physical distribution from central and eastern Nicaragua to RACCN. Paso Real Bridge on this route was lost due to severe flooding caused by Hurricane Mitch in 1998 and a temporary bridge was introduced some 300 m upstream of the original bridge location. The fragile structure of this temporary bridge caused concern in regard to safety and its single lane passageway prevented smooth traffic across the bridge. As this bridge was extremely important for the proper functioning of NR-21, the replacement of the temporary bridge by a new bridge with a sturdy permanent structure was an urgent task. Under these circumstances, the Government of Nicaragua made a request to the Government of Japan for the provision of grant aid cooperation and the E/N was signed in March 2014.

1.2 Project Outline

The purpose of the Project was to guarantee the safe and smooth flow of river-crossing traffic at Paso Real Bridge located on NR-21 in Matagalpa Department by replacing the existing temporary bridge with a permanent bridge, thereby contributing to the facilitation of the flow of goods along NR-21.

G/A Grant Limit / Disbursed Amount	1,521 million JPY / 1,241 million JPY	
Exchange of Notes Date / Grant Agreement Date	September 2014 / September 2014	
Executing Agency	Ministry of Transport and Infrastructure (MTI)	
Project completion	October 2016	
Project Area	Matagalpa Department	
Project proponents	Main Component	Hazama Ando Corporation
	Consultant	CTI Engineering International Co., Ltd.
	Procurement Agent	
Preparatory Study	November 2013 – August 2014	
Related Projects	The Rio Blanco-Siuna Bridges and National Road Construction Project (FY2017 an ODA loan project)	

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda, Global Group 21 Japan, Inc.

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: August, 2019 to August, 2020

Duration of the Field Survey: 10th to 28th November, 2019 and 16th to 21st February, 2020

3. Results of Evaluation (Overall Rating: A¹)

3.1 Relevance (Rating: ③²)

3.1.1 Consistency with the Development Policies of Nicaragua

At the time of planning, Nicaragua was implementing the National Human Development Program (*Programa Nacional de Desarrollo Humano*) in accordance with the 12 strategic programs, including “the development of social infrastructure and infrastructures for transportation, energy and production to transform Nicaragua” to improve the domestic social and environmental conditions and to reduce poverty. Under this program, MTI was energetically proceeding with the improvement of trunk roads through its own program designed to “consolidate the trunk road transportation network”.

At the time of this ex-post evaluation, infrastructure development is one of 19 strategic axes of the National Human Development Program (2018 – 2021) of Nicaragua, and transport infrastructure, including the trunk road network, tops the list of these strategic axes. Meanwhile, the Long-term National Transport Plan (*Plan Nacional de Transporte*) 2014 – 2033 of MTI upholds roads and bridges as essential infrastructure to secure the sustainable growth of the national economy and to reduce any disparity between the eastern and western regions of Nicaragua. This Plan lists such strategic targets as the establishment of a reliable road network, enhancement of the trunk road network and international corridors, enhancement of the road function regarding its vulnerability to disasters and enhancement of the road maintenance system.

Based on the above, the Project is highly relevant to Nicaragua’s development policies at the time of both ex-ante evaluation and ex-post evaluation.

3.1.2 Consistency with the Development Needs of Nicaragua

As already described in 1.1 Background, there was an urgent need for the replacement of the temporary Paso Real Bridge at the time of planning. NR-21, for which development under the Project was expected to play its part, was the only trunk road at the time of ex-post evaluation, connecting the very poor RACCN with other regions of Nicaragua as well as the Central American Corridors. The Long-term National Transport Plan 2014 – 2033 defines NR-21 as “the East-West International Corridor” and upholds the improvement of this route as one of the highest priority projects. As such,

¹ A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

² ①: Low; ②: Fair; ③: High

road and bridge improvement projects are being implemented along the entire route in addition to the Project.³ As described later in 3.3.2 Impacts, the traffic volume of Paso Real Bridge has shown an increasing trend, maintaining the necessity for the Project at the time of ex-post evaluation. Based on the above, the Project is relevant to the development needs of Nicaragua at the time of both planning and ex-post evaluation.



Source: Report for the Preparatory Study (partially edited)

Fig. 1 Location of Paso Real Bridge

3.1.3 Consistency with Japan’s ODA Policies

Japan’s Development Cooperation Policy for Nicaragua (March 2013) adopted the basic policy of assisting “stable economic growth based on a reduction of poverty as well as economic disparity” and identified three priority targets, i.e. “consolidation of infrastructure for the facilitation of economic development”, “social development of the poor and poor regions” and “environmental

³ Road improvement with pavement of some sections of NR-21 running from the municipality of Muy Muy to Puerto Cabezas has already been completed with the funding of other donors (Central American Bank for Economic Integration, etc.). Further improvement is gradually taking place at the remaining sections. The Rio Blanco-Siuna Bridges and National Road Construction Project, an ODA loan project of JICA, plans the replacement of four bridges on NR-21 and the improvement of a total of 120 km of road. According to the MTI, the entire road sections will be improved by 2023, while the entire improvement work including the work for bridges, will be completed in 2024. Road improvement projects were in progress near Paso Real Bridge at the time of ex-post evaluation targeting the section from Muy Muy to the project site (scheduled completion in 2020) and the section from the project site to Matiguás and further to Rio Blanco (scheduled completion in 2021).

conservation and disaster prevention”. As the Project directly and indirectly contributes to these targets, it is consistent with the said policy. As such, the 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 new Paso Real Bridge with a permanent structure was constructed under the Project. The planned and actual outputs of the Project are shown in Table 1. While the length of two caisson piles for the abutment on the left bank was changed to match the geology (depth of the bearing stratum) of the site which was discovered in the course of the detailed design, the other specifications were unchanged from the planned specifications. According to MTI, there were no problems with the planning and design of the Project and the construction quality was high.

Table 1 Planned and Actual Outputs of the Project

Item	Planned	Actual
Bridge Body	Bridge type: steel truss bridge Length: 170 m Total width: 9.9 m	Generally as planned (the length of two caisson piles for the abutment on the left bank was changed).
Access Roads	Starting point side: 225 m Termination point side: 285 m	As planned
Consulting Services	Detailed design, construction supervision	As planned

Source: Reference material provided by JICA

A range of works was planned as the undertaking by the Nicaraguan side, all of which, except for the removal of the existing temporary bridge, was implemented by the completion of the Project. While the superstructure of the temporary bridge was removed in the following year (2017) of project completion, bridge piers using containers filled with gravel and concrete are left untouched. While they spoil the beauty of the area somewhat, no problems have been experienced at the time of flooding, suggesting that they do not pose a dangerous risk.

- Acquisition of the construction site and relocation of houses
- Securing of land to accommodate a construction yard, stock yard, site office, construction road, etc.; payment of land rent; securing of land for a borrow pit, spoil bank and construction waste disposal site
- Extension of power to the site office; relocation of electricity poles and cables and communication facilities obstructing the construction work

- Issue of necessary permits, certificates, etc. and approval pertaining to the environment for the implementation of the Project
- Removal of the existing temporary bridge (including the reinforcing facilities for the temporary bridge after commencement of the construction of the new bridge)

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned total project cost was 1,535 million JPY (Japanese portion of 1,521 million JPY and Nicaraguan portion of 14 million JPY). The planned output for the Japanese portion of the project cost was reduced due to competition, resulting in an actual project cost of 1,241 million JPY (82% of the planned cost). As the main contractor has rich experience of overseas work, a substantial reduction of the project cost was achieved through the procurement of the base materials (steels) for the upper part of the bridge in Japan for their processing in Vietnam⁴, utilization of the local workforce and scaffolding materials (steel materials, etc.) used by the contractor in the work in Nicaragua until 2014 and other means. Meanwhile, the Nicaraguan portion of the project cost trebled (to 42 million JPY) due to the requirement for a much larger area than expected for the stock yard, forcing the relocation of an increased number of electricity poles, and other reasons. Nevertheless, the actual total project cost of 1,283 million JPY was much lower than originally planned (84% of the planned project cost).

3.2.2.2 Project Period

The Project was planned to be completed in 26 months from October 2014 to November 2016, including the period for tender. In reality, the Project was completed in the 25th month, the period being within the planned period, in October 2016 (96% of the planned period) from the signing of the consultant agreement in October 2014. According to MTI, the construction work for the bridge pier foundations employed a method never previously used by MTI where the ground was manually dug for a depth of more than 15 m while being protected by sheet piles. This work was completed without any problems by workers wearing an oxygen mask.

Based on the above, both the project cost and the project period were within the plan. Therefore, the efficiency of the Project is high.

3.3 Effectiveness and Impact ⁵ (Rating: ③)

3.3.1 Effectiveness

The Project was expected to achieve safe and smooth river-crossing traffic over Matagalpa River on NR-21, and the ex-ante evaluation sheet assumed “the relaxation of the vehicle weight limit” and “the increase of the average travelling speed” to be indicators. In this ex-post evaluation, “the

⁴ The overall cost was cheaper than in the case of processing in Japan even when the transportation cost to Vietnam is added.

⁵ The effectiveness is rated in consideration of not only the effects but also the impacts.

decrease of vehicles exceeding the weight limit” and “the decrease of traffic accidents” are added as indicators for safety, and “the decrease of traffic suspensions” as an indicator for traffic smoothness to analyze the effectiveness of the Project from both the safety and smoothness aspects of river-crossing traffic.

3.3.1.1 Realization of Safe River-crossing Traffic

(1) Relaxation of Vehicle Weight Limit

The preparatory study for the Project estimated that the maximum vehicle weight to use the temporary bridge without any problem was 14 tons. As the Project adopted the design standard for other bridges on national roads in Nicaragua (live load of 25 tons), the maximum vehicle weight to use the new Paso Real Bridge without any problem increased to 41 tons.⁶ This means that relaxation of the vehicle weight limit by the Project was achieved as planned.

(2) Decrease of Vehicles Exceeding the Weight Limit

According to the traffic volume survey conducted by the MTI in 2014, the total traffic volume of 1,241 vehicles per day (average annual daily traffic) at the temporary Paso Real Bridge included 90 vehicles per day consisting of triaxial trucks, which presumably exceed the weight limit of 14 tons (average weight of some 20 tons), as well as heavier trailers and 73 large buses per day (average weight of some 15 – 20 tons), all of which were seemingly causing a dangerous situation. In Nicaragua, the maximum total weight of a trailer is regulated to 41 tons and such vehicles can now use the new Paso Real Bridge without any problem. Additionally, prior to the implementation of the Project, wide-bodied large vehicles and heavy construction vehicles/machinery directly crossed the river without using the temporary bridge. Since the completion of the new bridge under the Project, any vehicles can now cross the bridge without any problem unless they are over-loaded. Based on the above, it is safe to believe that the number of river-crossing vehicles exceeding the new bridge’s weight limit has been substantially reduced.

The actual measurement of vehicle weight using the mobile weigh station owned by the MTI (August to December, 2018) recorded 829 out of 921 trucks (90%) weighed during this period as exceeding 14 tons.⁷ Without the Project, these 829 trucks would have exceeded the weight limit of the temporary bridge. Meanwhile, 26 out of 252 trailers measured during the same period exceeded 41 tons, indicating a state of over-loading. While most of them weighed within the permitted range for

⁶ The ex-ante evaluation sheet for the Project set the target value for the vehicle weight limit at 25 tons. According to the Consultant, this value was the “live load” used as the design standard and should not be compared to the reference value (14 tons).

⁷ Not every single truck was weighed at this mobile weigh station. No comparable data showing the situation before the Project was obtained. There is a possibility that the proportion of vehicles exceeding 14 tons could have been smaller as the improvement of roads and bridges under the Project and other projects may have caused the introduction of larger and/or heavier vehicles.

travel without any restriction (41 tons x 105% = approximately 43 tons),⁸ one trailer weighed 59 tons due to excessive over-loading.

The new Paso Real Bridge does not face any immediate danger even if a vehicle exceeding 41 tons uses it. However, repetitive use by over-loaded vehicles and speeding vehicles exceeding the design speed (40 km/hr) will damage the bridge and its access roads in the long term.

(3) Decrease of Traffic Accidents

According to the results of interviews with residents living near the new Paso Real Bridge and the Police offices, there were not many traffic accidents involving vehicles as vehicles could not travel at speed on the temporary bridge and its access roads before the Project. However, some accidents did occur, such as injury or falling in the river (including a fatal case) caused by contact between a vehicle and a pedestrian or animal on the narrow bridge. Since the completion of the Project up to the time of ex-post evaluation, no accident on the bridge or an access road has taken place, illustrating the real decrease of the number of traffic accidents.

While, most vehicles do not observe the speed limit (25 km/hr) in the school zone during commuting to and from a primary school located at the side of Paso Real Bridge (to be described later in more detail). In addition, the local topography necessitated that the access road on the west side has a steep, sharp bend with poor visibility and a likelihood of natural acceleration for vehicles. Road tacks were put near the bridge under the Project to decelerate the vehicle speed, but their small size means that larger vehicles can pass over them without decelerating. During commuting to the school, pupils (almost all walk on the south side) are overtaken by vehicles from behind. Although the traffic volume at this time is not high, some pupils can be seen walking on the roadway, stepping off the sidewalk of the bridge. For the above reasons, the evaluator believes there is a danger of accidents around the bridge.

3.3.1.2 Realization of Smooth River-crossing Traffic

(1) Increase of Average Travelling Speed

Prior to the Project, the temporary bridge had only one lane and the narrow width of this lane forced vehicles to travel slowly to avoid derailment and other accidents. The preparatory study for the Project ascertained that the average travelling speed on the bridge was approximately 17 km/hr. Because it was often necessary to wait for the passing of oncoming vehicles, a queue of up to 20 vehicles or so formed from time to time.

Actual measurement conducted in 2019 by MTI after the completion of the Project established an average vehicle travelling speed at the new Paso Real Bridge of 42 – 67 km/hr for

⁸ In Nicaragua, a vehicle which is over-loaded up to 5% is allowed to continue to travel with a fine but any vehicle exceeding 5% cannot continue to travel unless the state of over-loading is resolved by moving some of the cargo to another vehicle, etc. In the case of the vehicle weighing 59 tons mentioned in the main text, another vehicle was called to divide the cargo so that both vehicles were allowed to travel without exceeding the load weight.

trucks (average speed of 60 km/hr for four trucks) and 58 – 77 km/hr for bus and passenger cars (average speed of 68 km/hr for three vehicles). In the case of actual measurement at the time of ex-post evaluation, the travelling speed was reduced with a uniformed policeman standing at the side of the bridge to 24 – 38 km/hr for trucks (average speed of 28 km/hr for five trucks) and 34 – 72 km/hr for bus and passenger cars (average speed of 46 km/hr for nine vehicles). Waiting for oncoming vehicles as in the case of the pre-project period is no longer required. In short, the implementation of the Project has increased the average travelling speed, substantially reducing the time required to cross the river.

The existence of a primary school at the side of Paso Real Bridge makes the nearby road section, including the bridge, a school zone where the maximum speed is restricted to 25 km/hr. Because of this, the target average travelling speed across the bridge site was set at 25 km/hr at the time of planning and road signs and speed cushions were introduced. In Nicaragua, however, such speed limit for a school zone is routinely ignored and the actual average travelling speed exceeds 25 km/hr. According to local residents living near the bridge, no uniformed policeman is present most of the time. Based on the actual measurement results described above, it is concluded that most vehicles using Paso Real Bridge travel at a speed above the design speed.



Trucks crossing the bridge (left: transporting cattle towards Managua; right: transporting building materials towards the Caribbean Sea)



Traffic sign for the school zone



Pupils walking to the school

(2) Decrease of Traffic Suspensions

According to the results of interviews with road users,⁹ the temporary bridge was constructed not very high above the river. In the rainy season, the rising river water level due to rain often covered the road surface of the bridge, causing a dangerous situation. The partial submersion of the access roads led to frequent traffic suspensions. In addition, derailing incidents involving large vehicles crossing the bridge occurred throughout the year and traffic was suspended until the neighboring municipal authority or MTI could arrange heavy machinery for the removal of any derailed vehicle. Although there are no accurate records, traffic suspension due to rain is assumed to have occurred once or twice a week during the rainy season, lasting for several hours up to an entire day each time. Traffic suspension due to derailing occurred approximately once a month and more than a day was required each time to restore the normal traffic situation.

Since the completion of the Project, no traffic suspension has occurred. In October 2018, there was major flooding due to heavy rain and the river water level rose 1 – 2 m short of the level caused by Hurricane Mitch. However, the river-crossing traffic was not affected. Meanwhile, the river water level at this time was well above the elevation of the temporary bridge and a large drift tree could be seen hanging around the bridge pier. It is possible that the temporary bridge could have been washed away, causing long traffic suspension, if the new Paso Real Bridge had not been constructed under the Project.¹⁰

To summarize the effectiveness of the Project, the danger associated with the passing of overloaded vehicles above the weight limit was reduced after the completion of the Project and the number of accidents at the bridge was also reduced. Moreover, both the number of traffic suspensions across the river due to flooding, etc. and the river-crossing time were reduced. Apart from the fact that there is concern regarding contact accidents between pupils walking to and from school and passing vehicles, the Project has satisfactorily achieved its purpose of realizing safe and smooth river-crossing traffic. Therefore, the effectiveness of the Project is high.

⁹ As part of ex-post evaluation, interviews were conducted with the following bodies.

- Offices of nearby municipalities: Matiguas (Deputy Mayor; Head of Project Division); Muy Mui (Deputy Mayor); Matagalpa (Mayor); Rio Blanco (Mayor)
- Economic Organizations: Chamber of Commerce and Industry (President and 6 members); Matagalpa Livestock Producers' Association (President); Matagalpa Coffee Producers' Association (President)
- Transportation Sector: Bus Operators' Cooperative (6 long distance bus operators for bus services from Managua to Rio Grande and RACCN; carriers in Matiguas (two transporting cattle and one transporting milk); container carriers based in Managua, the capital; taxi drivers (one in Matiguas and one in Mui Mui); bus terminal manager (Muy Mui)
- Administrative bodies in nearby municipalities: Police (Matiguas and Mui Mui); hospital (Matiguas); kindergarten/primary school (in Matiguas, located next to the project site)
- Local residents along the route: residents, shop owners, restaurant owners, etc. along NR-21 near the project site (4 on the Mui Mui side and one on the Matiguas side); 2 restaurant owners at the bus terminal in Mui Mui

¹⁰ The remaining piers of the temporary bridge were completely submerged but did not suffer any lingering damage.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The Project was expected to contribute to the facilitation as well as smoothing of physical distribution through the achievement of safe and smooth river-crossing traffic over Matagalpa River on National Route 21. The economic and social impacts due to the changes of local traffic are analyzed below after confirmation of such changes of the river-crossing traffic over Matagalpa River resulting from the implementation of the Project.

(1) Changes of River-crossing Traffic

According to the traffic volume survey conducted by MTI, the traffic volume (average annual daily traffic) crossing Matagalpa River on National Route 21 has increased by 1.4 times in the last five years (Table 2). Trucks account for some one-third of this traffic. By type of vehicle, a large increase has occurred with motorcycles and large trucks (triaxial or larger)/trailers. This increase of the proportion of large trucks means an increased size of cargo-carrying vehicles, presumably because large vehicles which were formerly deterred from using the temporary bridge because of its narrow width or danger posed by the bridge's limited weight bearing capacity can now safely use the new bridge and also because large vehicles use the new bridge for road work on NR-21 and water supply work in progress in Puerto Cabezas.

Table 2 River-Crossing Traffic over Matagalpa River on National Route 21
(Annual average daily traffic: vehicles/day)

	Total	Motorcycle, etc.	Passenger Car	Bus	Truck	Small Truck (Coaxial)	Large Truck (triaxial or larger)/ Trailer
2014	1,241 (100%)	190 (15%)	521 (42%)	79 (6%)	451 (36%)	366	85
2019	1,728 (100%)	344 (20%)	729 (42%)	117 (7%)	538 (31%)	380	158
Size of Increase	1.4 times	1.8 times	1.4 times	1.5 times	1.2 times	1.0 times	1.9 times

Source: Reference material provided by the MTI

Note: Figure in brackets are proportions.

Based on information (origin, destination and type of cargo) obtained at the mobile weigh station established by MTI on passing cargo, the goods crossing Paso Real Bridge westwards are forest products (timber, wooden furniture, pallets, resin, etc.), livestock products (cattle, milk, cheese, etc.) and fisheries products. Some dairy products are exported to Honduras and El Salvador. Eastbound goods are various building materials (gravel, sand, cement, etc.), food (sugar, rice, meat, vegetables, etc.), beverages (beer, carbonated drinks, etc.), clothing, daily necessities, etc. Carriers report that the volume of timber transportation from RACCN has increased due to the progress of improvement of NR-21. Another report says that the transportation of building materials to RACCN is increasingly done by land, gradually replacing the traditional maritime transportation.

Bus traffic has increased by approximately 50% in the last five years which is mostly accounted for by small buses with a seating capacity of up to 30 seats (6 to 31; increase of 5.2 times) while large long distance bus traffic has not increased much (73 to 86; increase of 1.2 times). According to a cooperative of long-distance bus operators and bus terminal managers in the two nearby municipalities, the time-table for long-distance buses on NR-21 has not changed in the last five years. The exact reason for the increase of small buses is unclear but there is a possibility that these buses are used by workers involved in road work and others. The number of taxis operating in the two nearby municipalities has not changed in the last five years.

The traffic volume of motorcycles and passenger cars has considerably increased in the last five years. The exact reason is again unclear but two possible reasons are (i) the vitalization of economic activities along NR-21 due to the progress of road improvement work (for road sections other than the project site) and (ii) easy use of NR-21 by passenger cars with a low height because of the improved road and bridge conditions.

(2) Economic Impacts of Changes in Traffic

In interviews with road users, the economic impacts listed below were mentioned as consequences of the smoother river-crossing traffic and changes of traffic described above.

➤ The principal industry of the two nearby municipalities (Muy Muy and Matiguas) is the livestock industry. Beef cattle are shipped to Managua, etc. using biaxial or triaxial trucks. Raw milk is collected and shipped to Matagalpa, etc. and there is a small milk factory and cheese factory in Muy Muy. The elimination of the suspension of river-crossing traffic and ease of large vehicles to use the bridge have led to the following impacts.

- Beef cattle: The no more suspension of river-crossing traffic makes it easier to plan shipments enabling efficient shipment and transportation. Weight loss due to a long transportation time is contained,¹¹ keeping cattle in good condition. Large transport vehicles from Honduras, etc. can now use NR-12 for the export of local beef cattle.¹² In addition, double-decker trucks capable of transporting 50 – 60 head of cattle (usually 15 – 16 per truck) are newly operating.
- Raw milk: The no more suspension of river-crossing traffic means no more quality decline of raw milk due to a long transportation time. At a cheese factory near the bridge (west side), raw milk with declined quality was used for the production of cheese as it was unsuitable for processing as milk for drinking. Further deterioration of the quality of raw milk used to mean a poor cheese production yield but this has become a thing of the past since the completion of the Project.

¹¹ According to a beef cattle transporter, half-day transportation reduces the cattle weight by some 5%.

¹² According to a livestock raiser, the export of beef cattle to Mexico has become possible due to changes of the Mexican economic policy for Central American countries.

- As far as long-distance buses are concerned, some have been replaced by larger buses. However, neither the bus routes nor the service frequencies have changed. While, it has been pointed out that the improvement of the general road conditions has reduced the petrol cost as well as vehicle repair cost. Such a cost reduction is a synergy effect of the Project and other road improvement projects.¹³
- Several stores and restaurants have opened along NR-21, mainly on the side of Muy Muy. Existing restaurants say that the number of customers has increased slightly as a result of the increased traffic volume. On the Matiguas side, one restaurant is preparing to open for business.
- Many members of the Chamber of Commerce and Industry (approximately 160 business operators) of Matagalpa Department have clients on the east side of Paso Real Bridge towards Puerto Cabezas. Interviews with some members found that the improvement of NR-21 under the Project as well as other projects was believed to be very important for the improved efficiency and development of businesses and to have had the effect of pushing commercial and industrial activities forward. Such improvement leads to a shortening of the merchandise delivery time, reduction of the transportation cost (relative reduction of daily driver wages and reduction of the vehicle maintenance cost) and reduction of the damage to cargo during transportation. The geographical expansion of the transportation coverage has led to changes of the market conditions, including a wider market for some business operators (for example, a retailer of daily necessities and drugs based in Managua).
- According to a container carrier based in Managua, an assistant used to be required to guide a vehicle transporting a container in the past to prevent derailing when crossing the temporary bridge during the rainy season. The overall transportation time was long because of the poor condition of NR-21. Since the Project, such an assistant has no longer been required and the substantial shortening of the transportation time has reduced the overall transportation cost. The increased reliability of transportation means that business operators now rely on small volume transportation more frequently instead of stocking necessary goods in large quantities.
- During interviews with municipal offices, economic organizations and carriers, many people expressed the opinion that as NR-21 is the only road connecting RACCN with other regions in Nicaragua, the Project which has eliminated one bottleneck has had a nationwide impact. However, others have pointed out that the real impacts of the Project on economic activities are still some time away because the improvement of road and bridges on NR-21 is still on-going, the national economy of Nicaragua has been stagnant due to the rise of bank interest, and decline of investment since the autumn of 2018.

¹³ The length of the road sections which have been improved by other projects between Muy Muy and Puerto Cabezas is 385 km. In contrast, the improved road section under the Project is 0.7 km, making the contribution by the Project in this context rather small.

(3) Social Impacts of Changes in Traffic (Based on Interviews with Road Users, etc.)

During interviews with road users, etc., the following social impacts of the smoother river-crossing traffic and changes in traffic described above were mentioned.

- Prior to the Project, the access road (on the east side) to the temporary bridge was marred by poor visibility as there was a blind curved section surrounded by trees. Vehicles were forced to slow down or stop because of this as well as the narrow single lane bridge with alternate one way traffic. This situation led to frequent muggings at the curved section at a rate of up to once a week according to one report. Because of this, few vehicles, particularly passenger cars, used the bridge at night. With the new Paso Real Bridge constructed under the Project, the good visibility allows smooth traffic and no muggings have occurred.
- As there are no banks or hospitals and not many shops in Muy Mui, the residents of this municipality often travel to Matiguas by bus, passenger vehicle or motorcycle using Paso Real Bridge. Matiguas has several banks, a hospital and shops with a large variety of goods. It is believed that the Project has improved the convenience for people to travel to Matiguas from Mui Mui.
- The hospital in Matiguas (35 beds and 18 doctors) receives half of its outpatients from the west side of Paso Real Bridge. The director of the hospital told that as it is important to secure a permanent access to the hospital, including access by ambulances, the Project has contributed to facilitating the use of medical services by local residents.
- Residents living near the project site (especially those on the Matiguas side) expressed the opinion that it is no longer necessary for school children to take a detour and that the danger of crossing the narrow bridge has been reduced. Prior to the Project, occasional kind drivers stopped to allow children to safely cross the bridge as passing each other on the narrow bridge was dangerous. While the new bridge has sidewalks separated from the carriageways, some residents have expressed a slight concern that children walk at the side of fast-moving vehicles.

3.3.2.2 Other Positive and Negative Impacts

At the time of planning, it was judged that the Project would not have any major negative environmental and social impacts. Environmental impact assessment pertaining to the Project was not considered to be an obligatory requirement under the law of Nicaragua. The environmental permit, permit for the use of a spoil bank, permit to dig a borrow pit, permit to fell trees and permit to relocate the service lines were duly obtained as planned from the municipal authorities of Mui Mui and Matiguas. At the project site, 44 trees were felled and 440 trees and fruit trees were newly planted to compensate for the loss of the existing trees based on the environmental management plan. The widening of the access roads under the Project forced the relocation of one house and a bicycle repair shed. The interview with MTI and the affected household found that the process of relocation, which

was implemented in accordance with the JICA Guidelines for Environmental and Social Considerations and Nicaragua's related systems, did not pose any problems and that the family was satisfied with the compensation package. Interviews with MTI and other local residents did not find any negative environmental or social impacts.

Under the Project, MTI experienced a new bridge pier construction method (manual digging of the pier foundations shielded by sheet piles without the use of heavy machinery) for the first time. This method has since been used by the MTI for other bridges constructed with MTI's own funding, indicating the Project's impact on the dissemination of a new technology.

According to local residents, the river crossing area around the new Paso Real Bridge has a wide dry riverbed which used to be a leisure site. With the completion of a beautiful bridge, there are now more visitors enjoying picnics, etc.

The Project has largely achieved its objectives and, therefore, the effectiveness and impacts of the Project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional Aspect of Operation and Maintenance

The road section between MUY MUY and Matiguas, including the project site, is maintained by a contractor outsourced by the Road Maintenance Fund (Fondo de Mantenimiento Vial: FOMAV) under the supervision of MTI. To be more precise, a 57.7 km section between MUY MUY and Rio Blanco via Matiguas is maintained by 13 workers (at the time of ex-post evaluation) of the company (Micro Empresa San Jose Paiwa) outsourced by FOMAV. FOMAV uses an external consultant to evaluate the performance of this company and ensures the quality of the work by imposing a fine if the maintenance work is found to be inappropriate.

MTI conducts the regular inspection of bridges and roads and the necessary repair work is conducted by Corporation of Regional Construction Companies (Corporación de Empresas Regionales de la Construcción: COERCO), a national enterprise under the jurisdiction of the MTI. The project site is managed by the COERCO's branch office responsible for the northeastern part of Managua Department. The regular inspection of bridges, including the new Paso Real Bridge, is conducted by the Pavement and Bridge Inspection and Diagnostic Office (Oficina de Inspección y Diagnóstico de Pavimentu y Puerte) of the Directorate General of Planning of MTI while the regular inspection of road sections is conducted by an engineer in charge of the Road Maintenance Division of MTI.

As described above, the institutional set-up for the operation and maintenance of the Project is well established, posing no specific problems.

3.4.2 Technical Aspect of Operation and Maintenance

All staff members in charge of supervision of the maintenance of Paso Real Bridge at MITI, FOMAV and COERCO are engineers with either a graduate or post-graduate degree and work experience of 10 years or more, suggesting that they have sufficient technical competence for this work.

The access roads for Paso Real Bridge are concrete-paved roads and no advanced skills are required for their maintenance. The actual bridge section uses low alloy steels which are designed to form protective rust over the steel surface and this weather-resistant material can maintain its weather-resistant performance for a long time without anti-rust coating using organic solvent-based paint. Engineers of the MTI have basic knowledge of the maintenance of weather-resistant steel and no technical problems have occurred so far with the maintenance of the bridge section.

However, as Paso Real Bridge under the Project was only the third bridge to use weather-resistant steel in Nicaragua (all of which were constructed with Japanese grant aid), it cannot be said that Nicaragua has accumulated sufficient experience of their inspection and the capability to deal with any problems. In the case of the Project, an inspection manual for weather-resistant steel was provided by the consultant at the time of defect inspection but no practical training was organized. Moreover, the regular inspection recommended by the manual (two years after completion and every five years thereafter) to check the situation of the formation of protective rust has not yet started.

Based on the above, even though no major problems have been observed with the technical aspect of the operation and maintenance of the Project, there is room for improvement of the technical competence regarding the inspection and maintenance of the bridge which is constructed with weather-resistant steel.



Weather-resistant steel (the right-hand side is painted for aesthetic purposes)



Regular maintenance work in progress

3.4.3 Financial Aspect of Operation and Maintenance

The annual budget of FOMAV in FY 2019 is 1,701 million NIO (Nicaraguan cordova) (approximately 5.5 billion JPY), of which the sources are its own funds from the fuel tax on petrol, light oil, etc. and external loans by the World Bank and Inter-American Development Bank. Its own funds are 1,647 million NIO (approximately 5.3 billion JPY) which has recorded an increasing trend in the last three years. The maintenance cost (outsourcing cost of 1.4 million NIO per year: approximately 4.5 million JPY) for the road section (57.7 km), including the project-related section, is less than 1% of FOMAV's budget for FY 2019. As such, there is no financial concern on the part of FOMAV regarding the project-related section.

Meanwhile, the budget of the Road Maintenance Division of MTI in FY 2018 was 1,171 million NIO (approximately 3.8 billion JPY). Following the inspection of Paso Real Bridge, etc. conducted by MTI in July, 2019, the necessary repair cost was estimated to be 580,000 NIO (approximately 1.87 million JPY) and more than 90% of the required work was completed by the time of ex-post evaluation, excluding the repair of the paved surface of the access roads (as described later). As this project-related repair cost is far smaller than the entire road maintenance budget, there is no financial concern on the part of MTI regarding the Project.¹⁴

Based on the above, there are no major issues in financial aspect of the Project.

3.4.4 Current Status of Operation and Maintenance

At the time of defect inspection (November 2017) for the Project, there was no damage which quality as a defect and the bridge and road functions were soundly maintained. However, some metal members had been stolen and small cracks were found on the concrete pavement. These were repaired by the main contractor.

As part of the ex-post evaluation, the evaluator visited the project-related facilities together with an MTI engineer and found new cracks in more than 10 places on the concrete pavement of the access roads. Some of these had a surface opening of approximately 2 mm in width and more than 15 cm in depth, causing concern in regard to damage of the roadbed by infiltrating water. These cracks were previously found by the inspection conducted by the MTI in July, 2019 and the repair cost was estimated. MTI intends to finalize its response on receiving recommendations in the ex-post evaluation report. The cracks which were sealed by epoxy resin at the time of defect inspection show no special development. Meanwhile, the weather-resistant steels at the bridge section have developed protective rust on its



A crack on pavement

¹⁴ As COERCO budget is included in MTI budget, no analysis is conducted here concerning the budget of COERCO.

surface. Although a state of uneven rust is observed in some parts, the consultant for the Project has judged this to be normal based on photographs of the uneven rust. As such, this rust does not pose any problem.

The on-site visit as part of the ex-post evaluation found that routine maintenance by the contractor outsourced by FOMAV appears to have been adequately conducted. Such work is conducted approximately once a month to control vegetation, clean the water distribution facility, clear rubbish, manage trees, clean traffic signs and the road surface. Based on the above, no special problems are observed regarding the operation and maintenance situation of the Project although the cracks on the surface of the access roads require urgent repair.

4 Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The Project was implemented with the aim of achieving safe and smooth river-crossing traffic over Matagalpa River on NR-21 by replacing the existing Paso Real Bridge (temporary bridge) located in Matagalpa Department of Nicaragua with a permanent one, thereby contributing to the facilitation of the smooth flow of goods. At the time of both planning and ex-post evaluation, the Project is highly consistent with the development policy/plan and development needs of Nicaragua. As the Project is also consistent with Japan's assistance policy for Nicaragua at the time of appraisal, the relevance of the Project is high. The outputs of the Project are as planned with both the project cost and project period being within the planned ranges. Therefore, the efficiency of the Project is high. Since the implementation of the Project, there has been no traffic suspensions due to an increased river water level or other reasons at Paso Real Bridge, and the river-crossing time has been shortened. Moreover, the danger posed by over-loaded vehicles above the weight limit crossing the bridge and the number of traffic accidents on the bridge have been reduced. Apart from the fact that the speed limit is not totally adhered to, the purpose of the Project to realize safe and smooth river-crossing traffic has been achieved. The overall traffic volume has recorded an increasing trend, indicating certain positive socioeconomic impacts due to the facilitation and smoothing of physical distribution. Based on the above, the effectiveness and impact of the Project are high. No major problems have been observed in the institutional/organizational, technical and financial aspects of the operation and maintenance of the Project and, therefore, the sustainability of the effects realized by the Project is high.

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

4.2 Recommendations

4.2.1 Recommendations for the Executing Agency (MTI)

<Short-Term Recommendations>

- There is a need for the urgent and appropriate repair of cracks on the pavements of the access roads for Paso Real Bridge. Moreover, the said pavements should be inspected approximately once

a year in the future and any new cracks should be quickly repaired to prevent any adverse impact on the roadbed.

- There is a need for the introduction of speed bump to ensure the safety of children using Paso Real Bridge to go to school and to reduce the number of speeding vehicles above the design speed limit of 40 km/hr under the Project. The preferable design of the speed bump is to achieve a sufficient deceleration effect even for large vehicles while limiting damage to passing vehicles (smooth surface of 2 – 3 m in width and 0.1 – 0.2 m in height). These zones should be painted yellow or black, etc. to ensure sufficient visibility. In view of the possibility of vehicles rapidly accelerating after passing the deceleration zone, the introduction of four such bumps is recommended, consisting of two bumps at two entry points of the bridge and on both access road at the some 70 – 100 m point from the bridge.
- There is a need for MTI to enhance its technical competence for the inspection and maintenance of a bridge constructed with weather-resistant steel. The Rio Blanco-Siuna Bridges and National Road Construction Project (ODA loan project; 2017 –) which targets NR-21 plans the construction of bridges using weather-resistant steel. The organization of training on the inspection and maintenance of weather-resistant steel is recommended using the bridges constructed with such steel under the Project and the Project for Reconstruction of Bridges on Managua-El Rama Road (grant aid project; 2010 – 2013) as field training sites.

< Medium and Long-Term Recommendations >

- While NR-21 was unpaved for a long time, the road as well as bridges of this route have been progressively improved in recent years and the entire section up to Puerto Cabezas will be improved by 2024. The scaling-up of vehicles and the faster travelling speed made possible by this improvement generates concern regarding a higher possibility of traffic accidents involving local residents who are unfamiliar with such road traffic. This possibility necessitates that local residents along the route and drivers of bus companies, carriers, etc. which use NR-21 undergo effective safety education. One idea is a joint traffic safety campaign by MTI, the police, local schools, etc.
- Restrictions on over-loading by trucks using NR-21 will not only prolong the service life of the road and bridges but also lead to the reduction of traffic accidents. In view of the likelihood of the scaling-up of vehicles and increased traffic volume following the improvement of NR-21, it is necessary for the MTI to introduce a permanent truck weigh station along the route. The suggested location is the section between Muy Muy and Paso Real Bridge which is the starting point of NR-21.
- The remaining bridge piers of the temporary bridge which was mostly removed with the implementation of the Project do not particularly suggest any danger as they are. However, their removal is desirable, principally from the viewpoint of local beauty.

4.2.2 Recommendations for JICA

JICA should facilitate the implementation of the above short-term recommendations by MTI and monitor the state of their implementation.

4.3 Lessons Learned

Introduction of precise indicators matching the project purpose

The Project aimed at achieving “smooth” and “safe” river-crossing traffic and introduced such indicators as “the increase of the average travelling speed” and “relaxation of the vehicle weight limit” at the time of planning. However, the principal problems before the implementation of the Project were frequent traffic suspensions due to an increase of the river water level, use of the temporary bridge by vehicles exceeding the weight limit and contact accidents between vehicles and pedestrians on the narrow bridge, and the introduced indicators did not accurately reflect the need to improve these problems. On the other hand, “relaxation of the vehicle weight limit” is an indicator relating to a project output and cannot be described as an indicator for a project outcome. For this reason, additional indicators, i.e. “decrease of traffic suspensions”, “decrease of vehicles exceeding the weight limit” and “decrease of traffic accidents” were added in this ex-post evaluation for analysis of the effectiveness of the Project. The situation indicates the importance of clarifying the situation of problems to be dealt with by the project concerned and then introducing indicators for the outcomes to properly reflect the state of problem solving or improvement.

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