Federal Democratic Republic of Nepal

FY2023 Ex-Post Evaluation Report of Japanese Grant Aid Project

"The Project for the Rehabilitation of Sindhuli Road affected by Earthquake"

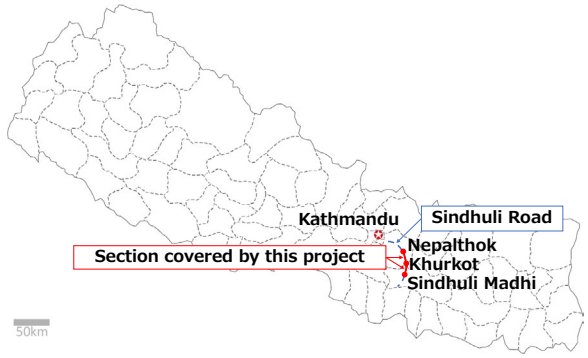
External Evaluator: Juri Ishimoto, Metrics Work Consultants Inc.

0. Summary

This project was implemented aiming to the traffic safety of road users by rehabilitating the Sindhuli Road damaged by the Nepal Earthquake in 2015, thereby contributing to social and economic development. This project is consistent with the development plan and development needs of Nepal at the time of planning and the ex-post evaluation. This project is also consistent with the Japan's ODA policy at the time of the ex-ante evaluation. Although collaboration with other organizations was not implemented, the capacity of the staff responsible for maintaining the Sindhuli Road has been strengthened and the improvements to the Sindhuli Road and the implementation of traffic safety measures were conducted through collaboration with other JICA projects. These collaborations have contributed to achieving the project's outcome of ensuring "traffic safety for road users." Therefore, the relevance and coherence are high. Both the project cost and project period were within the plan, and the efficiency is very high. The quantitative (increase in the number of passengers) and qualitative (improved resilience against disasters and a reduction of roadblock losses) effects set at the time of planning were confirmed to have been achieved. Furthermore, based on interviews with municipal officials and residents and satellite data analysis, the development of the Sindhuli Road is judged to have contributed to social and economic development. Therefore, the effectiveness and impact are high. Regarding sustainability, there are slight problems with the financial aspects of this project, but they are not considered to be serious. Therefore, the sustainability of the project effects is high.

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

1. Project Description



Project Locations

Photo (1) Anchor works developed by the project[1]

[1] Source: JICA documents

1.1 Background

The Sindhuli Road (160 km long) is a mountain road that crosses the Mahabharat Range (a range of 2,000-meter mountains separating Kathmandu, the capital of Nepal, from the Terai Plains in the south) and connects Kathmandu with the East Terai region. The construction of this road began in 1995 with Japanese grant aid and was completed in March 2015. As of June 2015, after completion, traffic on the Sindhuli Road averaged 4,297 vehicles/day, marking a significant increase from the average recorded in 2011 (1,764 vehicles/day). In addition, the travel time had been reduced from 9 hours to 5 hours, making the Sindhuli Road an important route for the movement of people and goods between Kathmandu and the East Terai region.

On April 25, 2015, however, just after the completion of road, an earthquake of magnitude 7.8, a level exceeding the design assumptions, occurred in Nepal, causing unexpected damages to 25 areas along the road, including road subsidence, cracks, the partial collapse of slopes, etc. JICA supported emergency restoration work on 12 high-priority areas from June 2015 onward, taking measures to ensure that traffic would not be impeded in the meantime. The emergency restorations, however, were limited to temporary waterproofing measures and the construction of temporary detour routes. With continuous heavy rains, erosion progressed, increasing the risk of road collapse. If the Sindhuli Road was to collapse, it was believed that, apart from the inevitable blocking of vehicular traffic, the cost of restoring the road would far exceed the cost of this project. To fully rehabilitate the damaged sections of the Sindhuli Road, the Government of Nepal requested Japan to implement the “The Project for the Rehabilitation of Sindhuli Road affected by Earthquake” (hereafter referred to as “this project”).

1.2 Project Outline

The objective of the project is to ensure the traffic safety of road users by rehabilitating the Sindhuli Road damaged by the Nepal Earthquake, thereby contributing to social and economic development.

Grant Limit / Actual Grant Amount	1,082 million yen / 1,077 million yen
Exchange of Notes Date / Grant Agreement Date	October 2018 / October 2018
Executing Agency	Ministry of Physical Infrastructure and Transport, Department of Roads (DOR)
Project Completion	January 2021
Target Area	Sindhuli District

Main Contractor	Hazama Ando Corporation
Main Consultant	Nippon Koei Co., Ltd.
Preparatory Survey	August 2017-April 2018
Related Projects	【Technical Cooperation】 The Project for Operation and Maintenance of the Sindhuli Road (Phase 2) (2019-2022) 【Grant Aid】 The Project for Construction of Sindhuli Road (1995-2015), The Project for Emergency Rehabilitation of Sindhuli Road (Section 4) (2003-2005)

2. Outline of the Evaluation Study

2.1 External Evaluator

Juri Ishimoto, Metrics Work Consultants Inc.

2.2 Duration of Evaluation Study

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

Duration of the Study: November 2023-January 2025

Duration of the Field Study: January 28, 2024-February 13, 2024, and May 26, 2024-June 1, 2024

2.3 Constraints During the Evaluation Study

Although cargo volume was set as a quantitative effectiveness indicator for this project, the DOR did not collect this data, and the evaluator was unable to conduct its own traffic volume survey to collect the actual values itself. Therefore, in this ex-post evaluation, the cargo volume indicator was used only as a reference, and the effectiveness was judged based on the passenger volume and qualitative effects.

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

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

3.1.1. Relevance (Rating: ③)

3.1.1.1 Consistency with the Development Plan of Nepal

The *Post Disaster Recovery Framework (2016-2020)* at the time of the planning aimed to restore

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

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

disaster-resistant social and physical infrastructure. Moreover, the emergency rehabilitation of the Sindhuli Road was identified as one of the priority rehabilitation projects. At the time of ex-post evaluation, the *National Transport Policy (2002-)* aimed to form a sustainable, reliable, affordable, safe, accessible, and self-reliant transport system that would lead to social, economic, and political transformation in Nepal.

As mentioned above, from the time of the planning to the time of the ex-post evaluation, the Government of Nepal identified the development of disaster-resilient transportation infrastructure as a key issue, and the Sindhuli Road is included in the scope of development. Therefore, this project is consistent with the development plan of Nepal.

3.1.1.2 Consistency with the Development Needs of Nepal

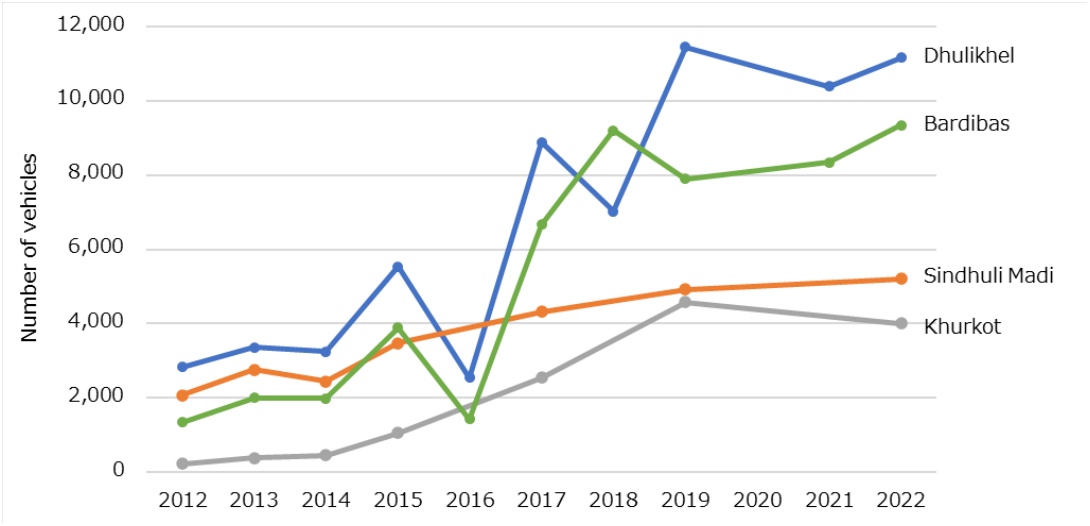
The Sindhuli Road is a mountain road that crosses the Mahabharat Range (a range of 2,000-meter mountains separating Kathmandu, the capital of Nepal, from the Terai Plains in the south) and connects Kathmandu and the East Terai region. The construction of this Road began in 1995 with Japanese grant aid and was completed in March 2015. On April 25, 2015, however, just after the completion of the road, an earthquake of magnitude 7.8, a level exceeding design assumption, occurred in Nepal, causing unexpected damages to 25 areas, including road subsidence, cracks, the partial collapse of slopes, etc. JICA supported emergency restoration work on 12 high-priority areas from June 2015 onward, taking measures to ensure that traffic would not be impeded in the meantime. The emergency restorations, however, were limited to temporary waterproofing measures and the construction of temporary detour routes. With continuous heavy rains, erosion progressed, increasing the risk of road collapse. If the Sindhuli Road was to collapse, it was believed that, apart from the inevitable blocking of vehicular traffic, the cost of restoring the road would far exceed the cost of this project.

The average daily traffic volume (vehicles/day)[4] on the Sindhuli Road has shown an increasing trend at the time of the ex-post evaluation (Figure 1). This increase attributed to the improved pavement of the Sindhuli Road and the road's effect in reducing the vehicle travel time from eastern Nepal to the capital. On the other hand, the increase in traffic has also resulted in traffic accidents. Under these circumstances, road users[5] are increasingly demanding and expecting the enhancements of the transportation capacity of the Sindhuli Road (a wider and safer road)[6].

[4] Vehicles were counted on two weekdays and one holiday at multiple locations along the Sindhuli Road, hence the average was calculated by dividing the three-day total by the number of days (3 days). Traffic moving in both the [uphill and downhill] directions was included in the total. (Source: Questionnaire responses from the project stakeholders).

[5] Trade and Export Promotion Center staff, municipal officials, residents living near the Sindhuli Road, etc.

[6] Source: *Final Report on the Data Collection Survey on the Sindhuli Road Capacity Enhancement in Nepal (2022)*.

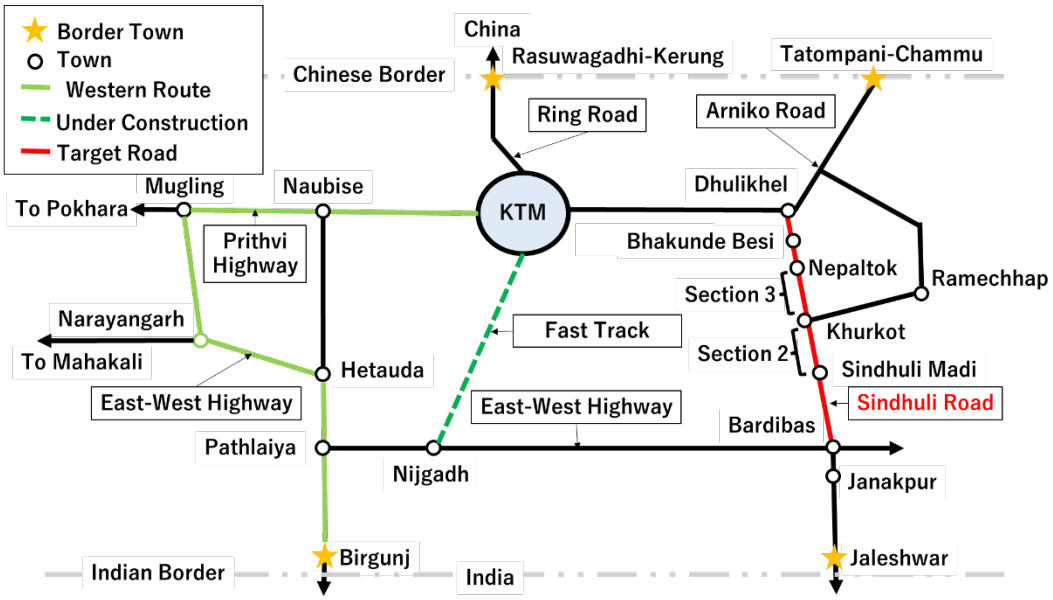


Source: Prepared by the evaluator based on documents from" The Project for Operation and Maintenance of the Sindhuli Road (Phase 2)"
Note 1: The traffic volume in 2016 was temporarily reduced due to road closures caused by the Nepal Earthquake and border blockades between Nepal and India. (Source: Questionnaire responses from the project stakeholders)
Note 2: No traffic volume surveys were conducted in any part of Nepal in 2020, or in Sindhuli Madi and Khurkot in 2016, 2018, and 2021. (Source: Questionnaire responses from the project stakeholders)
Note 3: The Sindhuli Road opened in 2015; traffic counts from 2012 to 2015 are based on vehicles passing through the existing road, not the Sindhuli Road. (Source: Questionnaire responses from the project stakeholders)

Figure 1: Average daily traffic volume on the Sindhuli Road (vehicles/day)

In addition, a new highway (Fast Track: between the capital Kathmandu and Nijgadh) (green dotted line in Figure 2) is under construction and is expected to be completed in April 2027[7]. When completed, this highway will shorten the travel time from Kathmandu to Birgunj compared to the western route (Kathmandu-Naubise-Mugling-Narayangarh-Hetauda-Birgunj). According to the DOR, however, the toll for this highway is expected to be set at a high rate. As a result, vehicle users, especially those who previously used the western route, may opt to continue using the western route instead of the highway. Therefore, the traffic volume on the Sindhuli Road is not expected to decrease significantly.

[7] Source: Questionnaire responses from DOR



Source: Prepared by the evaluator based on the Final Report on Data Collection Survey on the Sindhuli Road Capacity Enhancement in Nepal.

Figure 2: Major roads around the capital

As mentioned above, the restoration of the earthquake-damaged sections of the Sindhuli Road was considered important during the planning of this project, given the significant risk of road collapse. Furthermore, during the ex-post evaluation, the traffic volume on the Sindhuli Road has increased, and the development of the Sindhuli Road as a safe and disaster-resistant road is considered important. Therefore, this project is consistent with the development needs of Nepal.

3.1.1.3 Appropriateness of the Project Plan and Approach

Change of Plan

The delays and additional costs[8] incurred due to the evacuation and standby of construction contractors during the COVID-19 period necessitated an extension of the project implementation period and additional grants. This change was considered unavoidable, as the outbreak of COVID-19 had not been foreseen. The change of contract was also made through the formal procedures of JICA[9]. Therefore, the changes in plans are judged to have been appropriate.

Application of Lessons Learned

JICA learned from the ex-post evaluation of the Grant Aid, "The Project for the Emergency Rehabilitation of the Sindhuli Road (Section 4)" (2003-2005), that the future traffic volume and disaster risk should be considered in the disaster recovery planning, and that the capacity of the

[8] Labor costs during evacuation and standby periods, airfare during evacuation, and costs associated with re-installation of construction equipment. (Source: JICA documents)
[9] Source: JICA documents

implementing agency should be strengthened to promote the maintenance of the collapsed sections. The road design in this project specified that the road should withstand an earthquake of the same magnitude as the Nepal earthquake that occurred in 2015, and the necessary maintenance items, as well as the necessary budget, were compiled and agreed upon with the implementing agencies[10] while duly noting the possible future earthquake risks. In addition, the technical assistance, "The Project for Operation and Maintenance of the Sindhuli Road Phase 2 (SROM2)" (2019-2022), provided training for the DOR staff on asphalt concrete design (overlay[11]) and bridge design. This training strengthened the maintenance capacity of the DOR staff[12].

As stated above, while the change of contract was concluded during the project implementation, this change was judged to be appropriate. In addition, lessons learned from other projects were utilized and the necessary design and DOR capacity enhancements were implemented to ensure sustainable operation and maintenance. There were no significant differences in the planning and implementation of the project (see "3.2 Efficiency" below), and the project plan and approach are judged to have been appropriate.

3.1.2 Coherence (Rating: ③)

3.1.2.1 Consistency with Japan's ODA Policy

The *Country Development Cooperation Policy for Nepal (2016)* identified strengthened disaster management and the development of transportation infrastructure for better reconstruction as priority areas. Therefore, this project is consistent with Japan's ODA policy.

3.1.2.2 Internal Coherence

As assumed at the time of planning, the staff responsible for the maintenance of the Sindhuli Road participated in the SROM2 training, and acquired skills related to road maintenance.

Furthermore, the ex-post evaluation confirmed that the synergistic effects were greater than planned: SROM2 resulted in improved pavement on the Sindhuli Road, installation of curve mirrors and guard blocks on the shoulders, improvements from the causeway to bridge, and the implementation of training in Japan for DOR engineers and traffic safety awareness programs for 25 roadside schools (50 teachers in total). In addition, a traffic safety management plan developed based on 8 years of traffic accident data contributed to the reduction of accidents on the Sindhuli Road. In addition, the SROM2 project team and DOR conducted a collaborative study on sidewalks to identify and prioritize locations where sidewalks should be constructed between Bardibas (see Figure 2) and Sindhuli; DOR is constructing sidewalks on the Sindhuli Road in

[10] Source: Ex-ante evaluation form
[11] Repairing cracked or thinned road asphalt by replacing it and covering it with new asphalt.
[12] Source: Questionnaire responses from the implementing consultant, questionnaire responses from the project stakeholders, and questionnaire responses from DOR

phases based on this, according to budget[13].

As mentioned above, the collaboration with SROM2 has strengthened the capacity of the DOR staff to maintain the Sindhuli Road and has conducted the improvement of the Sindhuli Road and traffic safety measures. These collaborations have contributed to achieving the project's outcome of ensuring "traffic safety for road users."

3.1.2.3 External Coherence

No specific collaboration or coordination was assumed for this project at the time of the planning or considered or implemented during the implementation[14].

The project is consistent with the development plan and needs of Nepal at the time of planning and the ex-post evaluation. The project plan and approach are also judged to be appropriate. In addition, this project is consistent with Japan's ODA policy at the time of the ex-ante evaluation. Although collaboration with other organizations was not assumed at the time of planning, collaboration with other JICA projects exceeded the initial expectation, and concrete results were confirmed. Therefore, its relevance and coherence are high.

3.2 Efficiency (Rating: ④)

3.2.1 Project Outputs

The planned outputs (civil works) are shown in Table 1. The project was implemented as planned[15].

Table 1: Planned Outputs

Target Area	Type of Works	Content and Scale
Sta.17+400 Section 2	Ground anchors	Width of construction extension: 80 m Number: 158 pieces
	Crib works F500	Area: 1,270 m^2 Area of mortar inside the frame: 860 m^2
	Crib works F300	Area: 1,060 m^2 Area of mortar inside the frame: 710 m^2
	Rock bolts	Length: 3 m/each Number: 300 bolts
	Excavation works	Volume of excavation by hand: 370 m^3
	High-intensity net	Area of high-intensity net: 2,800 m^2 Length of rock bolts: 3 m/bolt, Number: 1,240 bolts
	Vegetation works	Vegetation back-spraying: 4,140 bags
	Gabion check dams	Volume of gabion: 350 m^3
	Asphalt pavement	Area: 420 m^2
Sta.33+440 Section 2	Ground anchors	Width of construction extension: 35 m Number: 32 anchors

[13] Source: Questionnaire responses and interview results with DOR

[14] Source: Ex-ante evaluation form, questionnaire responses from the implementing consultant, questionnaire responses from DOR.

[15] Source: JICA documents and visual confirmation during site visits

	Anchor plates	32 units
	H beam installation	Area of mortar: 160 m^2 Number of H beams: 32 Volume of concrete: 25 m^3
	Restoration of side ditch	Length: 43 m
	Asphalt pavements	Area: 200 m^2
Sta.33+695 Section 2	Ground anchors	Width of construction extension: 20 m Number: 18 anchors
	Anchor plates	18 units
	H beam installation	Area of mortar: 95 m^2 Number of H beams: 18 Volume of concrete: 19 m^3
	Restoration of side ditch	Length: 45 m
	Asphalt pavements	Area: 150 m^2
Sta.11+620 Section 3	Ground anchors	Width of construction extension: 30 m Number of anchors: 20
	Anchor plates	20 units
	H beam installation	Area of mortar: 90 m^2 Number of H beams: 10 pieces Volume of concrete: 10 m^3
	Side ditch	Length: 12m
Sta.15+520 Section 3	Ground anchors	Width of construction extension: 40 m Number of anchors: 40
	Anchor plates	40 units
	H beam installation	Area of mortar: 250 m^2 Number of H beams: 40 Volume of concrete: 50 m^3
	High-intensity net	Area of high-intensity net: 2,500m^2 Length of rock bolts: 3 m/bolt, Number: 1,100 bolts
	Asphalt pavement	Area: 210 m^2

Source: JICA documents

Photo (2) Anchor construction of Sta. 17+400

Photo (3) Anchor construction of Sta.33+440

Photo (4) Anchor construction of Sta.33+695

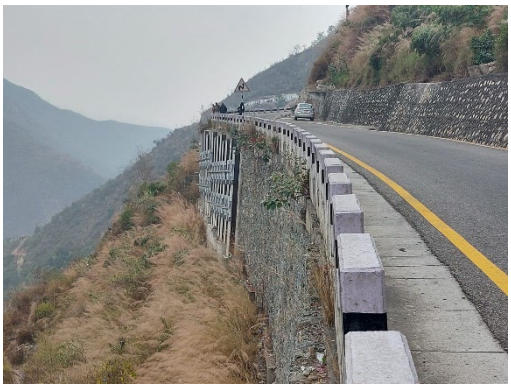


Photo (5) Anchor construction of Sta.11+620

Photo (6) Anchor construction of Sta.15+520

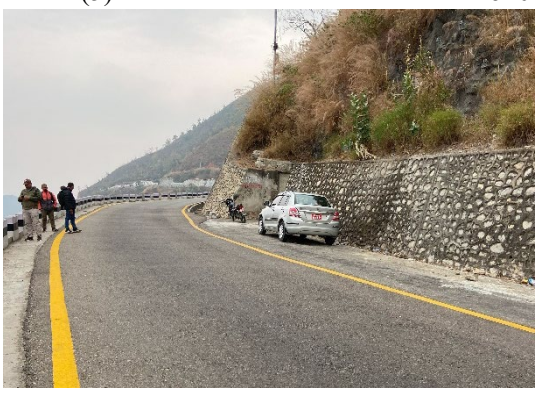


Photo (7) Road condition of Sta.15+520

Source: Photographed by the evaluator during the field survey

Figure 3: Status of implementation of the outputs

The Japanese output (consulting services) was also implemented as planned[16].

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned and actual project expenses for each country are shown in Table 2. Actual project expenses were within the plan (100% of the plan).

[16] Source: Questionnaire responses from the implementing consultants and from DOR

Table 2: Planned and Actual Project Costs

(Unit: million yen)

Country	Burden of responsibility	Plan*1	Actual
Japan	Construction, design supervision, preliminary expenses	1,082	1,077
Nepal	Land lease and compensation, relocation of utilities, environmental monitoring, slope monitoring, initial environmental survey, bank account opening, and afforestation	4	4
Total		1,086	1,081

Source: JICA documents

*1: The initial contract was for a total of 1,051 million yen, but an additional grants contract was signed. As described in "3.1.1.3 Appropriateness of the Project Plan and Approach," this ex-post evaluation determined that the revised contract was appropriate, and the project cost after the conclusion of the additional grant contract was considered to be the plan and compared it with the actual cost.

3.2.2.2 Project Period

This project was implemented from October 2018 to January 2021 (28 months). The project period was planned to run from October 2018 to July 2020 (22 months) but was changed to October 2018-January 2021 (28 months) during project implementation due to the impacts of COVID-19. This change was based on the additional grant G/A dated August 18, 2021, which confirmed the formal agreement with the implementing agency; hence, the changed project period was to be used as the planned value in the ex-post evaluation. The planned and actual results for the modified project period are shown in Table 3. As shown, the actual results for the project period were within the plan (100% of the plan).

Table 3: Planned and Actual Project Period

Plan	Actual
October 2018 - January 2021 (28 months) *1	October 2018 - January 2021 (28 months)

Source: Ex-ante evaluation form and JICA documents

*1: The definition of project start is the conclusion of G/A, and the definition of project completion is the completion of construction work. Comparing the originally planned project duration (22 months) to the actual project duration (28 months), the project duration is 127%.

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

3.3 Effectiveness and Impacts[17] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the time of planning, the number of passengers and the cargo volume were set as quantitative effects (operational and effectiveness indicators) of the project.

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

Table 4: Operational and Effectiveness Indicators

Indicator		Baseline value *1 2017	Target value*2 2023 3 Years After Completion	Actual value*3 2022
Number of passengers (persons/year)	Khurkot	6,006,205	8,048,000	17,553,580
	Sindhuli Madi	5,847,170	7,835,000	18,149,990
Cargo volume (ton/year)	Khurkot	359,896	482,000	NA
	Sindhuli Madi	492,042	659,000	NA

Sources: Preparatory Survey Report, ex-ante evaluation form, JICA documents, questionnaire responses from DOR.
*1: A traffic volume survey and a passenger and cargo volume survey were conducted at the time of planning. Based on the results of those surveys, the base value was calculated by multiplying the average traffic volume by vehicle type (vehicles/day) x average number of passengers by vehicle type (passengers/unit) (average cargo volume by vehicle type (t/year)) x 365 days. For both Khurkot and Sindhuli Madi, passenger and cargo volumes were calculated from two-way traffic volumes. (Sources: preparatory survey report, questionnaire responses from the implementing consultant).
*2: Estimates are based on 2017 baseline values increased by 5% per year. (Source: Preparatory survey report)
*3: No traffic volume survey was conducted in 2023, and no cargo volume survey was conducted. (Sources: Questionnaire responses and interviews results with DOR)

Number of Passengers

As of 2022, the actual values are significantly higher than the target values. The reason for this is the significant increase in traffic on the Sindhuli Road, as discussed in "3.1.1.2 Consistency with the Development Needs of Nepal." Table 5 compares the base value (2017), target value (2023), and actual value (2022) of average vehicle traffic volumes (vehicles/day) in the Sindhuli Madi. The actual traffic volumes exceed the base and target values for all vehicle types. In particular, the traffic volumes of car/jeep/taxi, microbuses, and motorcycles have reached approximately twice the target value.

Table 5: Average Traffic Volume of Vehicles (vehicles/day)

	Car/Jeep/Taxi	Large bus	Small bus	Microbus	Motorcycle
Baseline value (2017)	690	16	112	363	2,822
Target value (2023)	924	22	150	486	3,781
Actual value (2022)	1,830	32	220	907	7,395

Source: Preparatory Survey Report and questionnaire responses from DOR.

Cargo Volume

As no cargo volume surveys were conducted on the Sindhuli Road, actual values could not be collected during the ex-post evaluation. As shown in Tables 6 and 7, however, the actual average cargo (truck) traffic volumes (vehicles/day) in Khurkot and Sindhuli Madi are well above the

baseline values. The actual value exceeded the target value, moreover, in Sindhuli Madi. Therefore, the cargo volume is assumed to also exceed the target value.

Table 6: Average Cargo Traffic Volume (vehicles/day) in Khurkot

	Multi-axis truck	Large truck	Lightweight truck
Baseline value (2017)	1	190	39
Actual value (2022)	31	452	324

Note: No target values are estimated in Khurkot.
Source: Preparatory Survey Report, questionnaire responses from DOR.

Table 7: Average Cargo Traffic Volume (vehicles/day) in Sindhuli Madi

	Multi-axis truck	Large truck	Lightweight truck
Baseline value (2017)	47	181	18
Target value (2023)	63	242	24
Actual value (2022)	433	362	354

Source: Preparatory survey report, questionnaire responses from DOR.

3.3.1.2 Qualitative Effects (Other Effects)

The qualitative effects expected from the project were "increased resilience to disasters," "increased traffic safety for road users," and "reduced roadblock losses."

Increased Resilience to Disasters

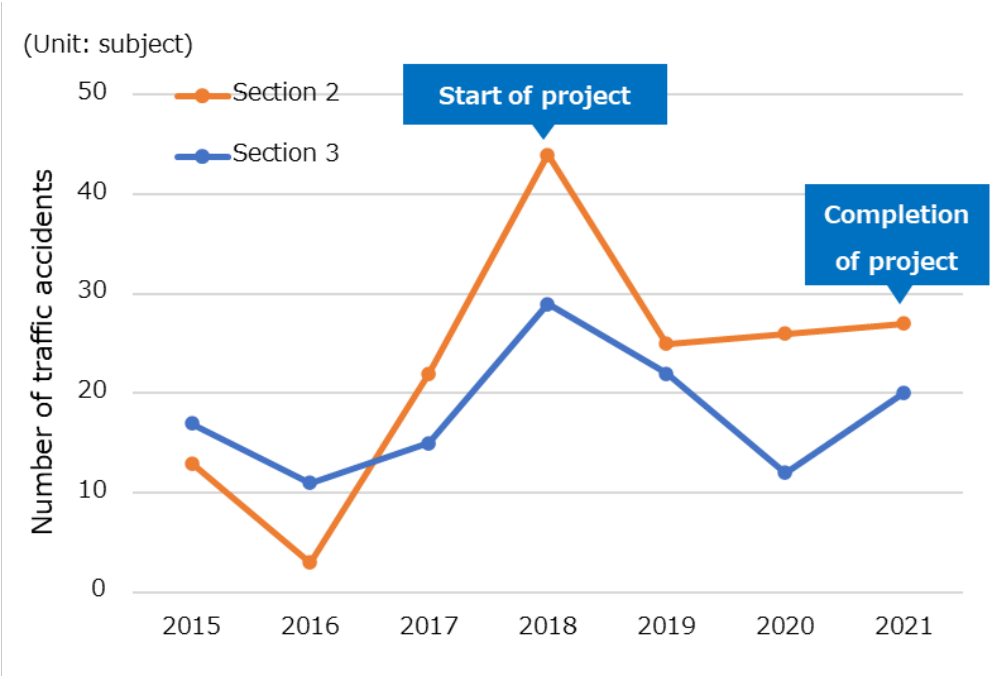
Areas vulnerable to earthquakes were reinforced during the project in accordance with the design policy of preventing disasters in the event of an earthquake of the same magnitude as that in 2015. The maximum horizontal acceleration in the vicinity of the Sindhuli Road was estimated based on data on the maximum acceleration of the Gorkha earthquake provided by the U.S. Geological Survey. The design external force[18] was the earth pressure[19] during the earthquake when the design horizontal intensity[20] was set at 0.20. The scale of seismic motion at the time of the disaster was assumed using seismic response analysis[21], and it was confirmed that the gabion wall[22] would not collapse if subjected to the same level of seismic motion[23]. Given that the reinforcement work against earthquakes was implemented based on careful estimations, this project is judged to have improved the resilience to disasters.

[18] A generic term for externally acting forces considered in a building during an earthquake.
[19] The pressure exerted by the soil on the building during an earthquake.
[20] Quantitative expression of the magnitude of horizontal force acting on a building during an earthquake.
[21] An analytical method for predicting how the ground will shake during an earthquake.
[22] A retaining wall made of stones packed into a box-shaped frame made of metal wires.
[23] Source: Questionnaire responses from the implementing consultant and from DOR.

Increased Traffic Safety for Road Users

Although road subsidence was observed in this project's target sections (sections 2 and 3), it was repaired through this project and the road subsidence and landslides were resolved[24].

Furthermore, a decrease in the number of traffic accidents was observed at the completion of the project (2021) in comparison to that at the start (2018) (see Figure 4). The number of traffic accidents in the second section covered by the project decreased from 44 at the start of the project to 27 at project completion. The number in the third section also decreased from 29 at the start of the project to 20 at project completion. Though an increase was observed from 2020 to 2021, the number of traffic accidents was still improved from that before the start of the project (2018), which was the highest number recorded. According to the project stakeholders, the implementation of a traffic safety awareness program in SROM2 and the installation of speed limit signs contributed to the decrease in the number of traffic accidents.



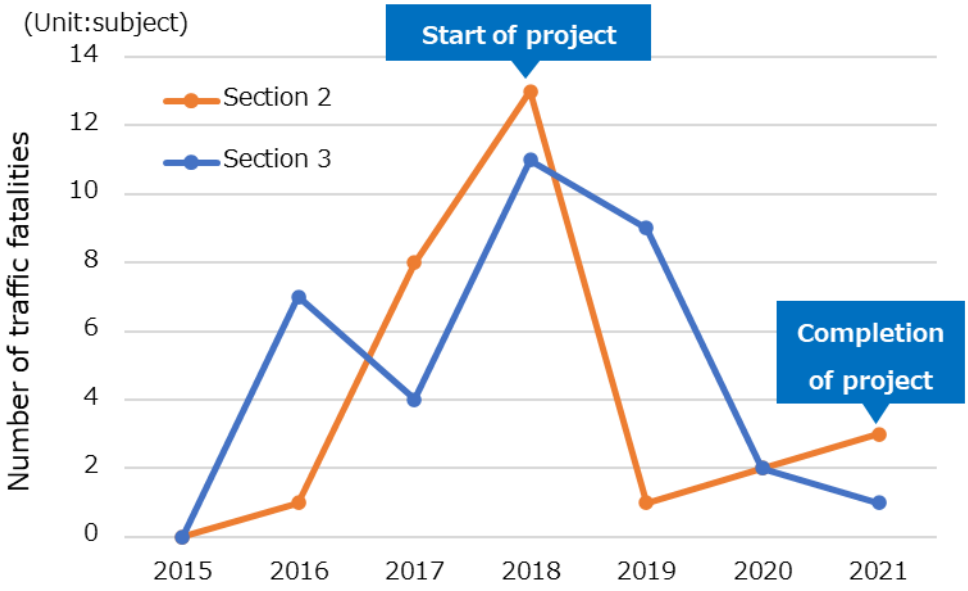
Source: Prepared by the evaluator based on SROM2 documents.

Figure 4: Number of traffic accidents on the Sindhuli Road (Sections 2 and 3)

In addition, as with the number of traffic accidents, a decrease in the number of traffic fatalities was observed at the completion of the project (2021) compared to the number at the start (2018) (see Figure 5). In Section 2, the number of traffic fatalities decreased from 13 at the start of the project to 3 at project completion. In Section 3, the number decreased from 11 at the start of the project to 1 by the time the project was completed. Though an increase from 2020 to 2021 was observed in section 2, the number of traffic fatalities was lower than that before the project launch

[24] Source: Interviews with DOR

in 2018, when the highest number was recorded.



Source: Prepared by evaluator based on SROM2 documents.

Figure 5: Number of traffic fatalities on the Sindhuli Road (Sections 2 and 3)

On the other hand, though not included among the direct impacts of this project, the following concerns were noted for the Sindhuli Road. These concerns are thought to have impacts on traffic safety and to increase the number of dangerous and accident-prone areas.

- A local resident[25] pointed out that schoolchildren were afraid to walk on the side of the Road due to the narrow width of the sidewalks. A visual inspection during the field survey also confirmed that the Road and bridge widths were narrow (Figure 6 (8)). According to DOR, on the other hand, JICA experts and DOR conducted a joint survey in SROM2 to identify areas where sidewalks were needed and are currently constructing them in phases. DOR informed us that an 11-km long sidewalk has already been constructed from Bardibas to Dhulikhel (Fig. 6 (9)).
- The average speed on the Sindhuli Road in 2019 was 39.35 km/h. Although the speed limit is stipulated to be 20 km/h in Section 2 and 3 (covered by the project), drivers disregard the speed limit and the actual speed of vehicular travel is much higher than the limit posted on the signs[26]. Disregard of the speed limit, especially by motorcyclists, has led to traffic accidents (collisions with other vehicles and roadside posts).

[25] At the time of the ex-post evaluation, 10 residents (7 males and 3 females) living near the Sindhuli Road were interviewed.
[26] Source: SROM2 document

Photo (8) Sidewalk on the Sindhuli Road (outside the yellow line)

Photo (9) Newly constructed sidewalk (red line)

Source: Photographed by the evaluator during the field survey

Figure 6: Maintenance status of the sidewalk on the Sindhuli Road

Reduced Roadblock Losses

No roadblocks had occurred up to the time of the site survey since the completion of the project[27]. Therefore, it is judged that the project has reduced losses due to roadblocks.

The above results confirm that both quantitative (increase in the number of passengers) and qualitative (increased resilience to disasters and reduced roadblock losses) effects were achieved. Regarding the traffic safety of road users, on the other hand, concerns were raised about the narrowness of the sidewalk and travel speeds throughout the Sindhuli Road. These concerns, however, are excluded from consideration in the evaluation, as they are not attributable to this project. Therefore, it is judged that the expected effect, traffic safety for road users, has mostly been achieved.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The expected impact of the project was “social and economic development.”

<Economic Development>

The GDP growth rates for Nepal are shown in Table 8. Due to the impact of COVID-19, Nepal’s economy as a whole was stagnant over the period of time in 2019/20. GDP growth also temporarily declined in Bagamati Province, which includes the area covered by this project, but has since been recovering.

[27] Source: Questionnaire responses from DOR

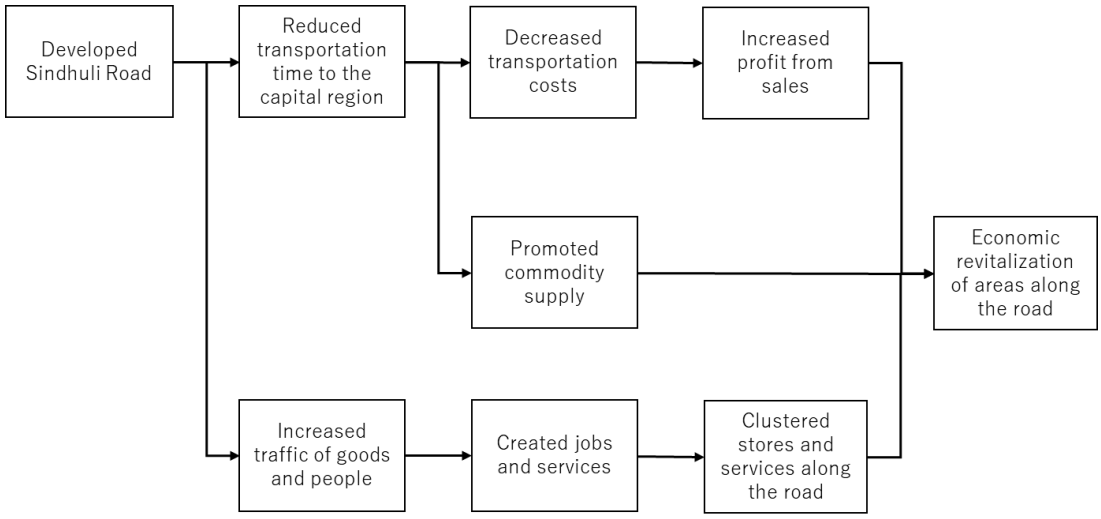
Table 8: GDP Growth Rates (%)

Year*1/Province	Koshi	Madhes	Bagamati	Gandaki	Lumbini	Karnali	Sudur Paschim	Nepal
2018/19	7.23	8.00	5.59	6.93	6.89	8.42	6.73	6.66
2019/20	0.03	-2.03	-5.69	-0.71	-0.84	1.39	2.00	-2.37
2020/21	5.05	4.48	5.08	4.21	4.72	5.00	4.78	4.84
2021/22	5.47	4.63	6.30	6.35	5.03	5.32	4.78	5.61
2022/23	2.00	1.69	1.44	3.26	2.06	1.91	1.78	1.86

Source: National Statistics Office, Nepal (2023)
*1: It represents Nepal's fiscal year (July-June).

As described above, economic development was confirmed at the time of the ex-post evaluation. However, it remains unclear how the development of the Sindhuli Road has contributed to economic development. Therefore, we decided to conduct a qualitative assessment to explore how the development to the Sindhuli Road have impacted economic growth.

The changes shown in Figure 7 were identified as a result of past ex-post evaluation reports[28] and interviews with local residents in the surrounding area and municipal officials during the field survey[29]. Given that various factors affect the economic development of a country, it cannot be said that economic development was achieved solely by the development of the Sindhuli Road. However, as shown in the figure below, the development of the Sindhuli Road is considered to have contributed to economic development by improving transportation access to the capital region and spurring a revitalization of commercial activities in the areas along the road.



Source: Prepared by the evaluator

Figure 7: Changes identified during the ex-post evaluation

[28] *FY2015 External Ex-post Evaluation Report, The Project for Construction of Sindhuli Road (Section 2 (Phase3/3) and Section 3)*
[29] Ten residents (7 males and 3 females) in the area surrounding the Sindhuli Road and 4 municipal officials (males) were interviewed.

Descriptions of how the respective changes are generated follow below.

Reduced Transportation Time to the Capital Region

- The time to travel from the capital to the south was reduced from about 9 hours before the opening of the Sindhuli Road to about 5 hours after the opening[30]. The Sindhuli Road has reduced the travel time for small cargo vehicles[31] and decreased the cost of transportation within the country[32].
- The citrus fruit called Junar is produced in the Sindhuli District. Before the opening of the Sindhuli Road, Junar fruits were placed in bamboo baskets and transported on foot to the capital region in a journey that took about 1.5 days. The dealers had difficulty in raising the selling price to cover the high transportation costs, and thus earned only a small profit. At the time of the ex-post evaluation, however, the use of the Sindhuli Road had shortened the transportation time to the capital region and reduced transportation costs. This resulted in an increase in the profit received by the farmers from the dealers from 10 NPR per kg before the project to 55 NPR per kg at the time of the ex-post evaluation. (Source: Junar Central Cooperative Union ltd.)

Promoted Commodity Supply

- Current crop production in the Sindhuli District has increased significantly from before the opening of the Sindhuli Road. The opening of the Sindhuli Road has improved access to markets for farmers and dealers, which has led to increased production. (Source: Prime Minister Agricultural Modernization Project (hereinafter referred to as "PMAMP"[33]) office director)
- The production of Junar was much lower before the opening of the Sindhuli Road than it is today[34]. However, the awareness of the profit potential of Junar has now increased, which has attracted the interest of many farmers. Sindhuli District is very well suited for Junar production[35]. The improved access to transportation facilities via the Sindhuli Road is one of the factors that have allowed farmers to gradually expand their farmland area and sustainably produce Junar. (Source: Junar Central Cooperative Union ltd.)

[30] Source: Questionnaire responses from DOR, interviews results with the Trade and Export Promotion Center, interviews results with municipal officials in Sindhuli Bazar.
[31] The Sindhuli Road is narrow and was not designed for large cargo vehicles. Therefore, large cargo vehicles travel between Nepal and India via the western route (Kathmandu - Naubise - Mugling - Narayangarh - Hetauda - Birgunj). (Source: Interview results with the Trade and Export Promotion Center; interview results with DOR)
[32] Source: Interview results with the Trade and Export Promotion Center
[33] A project by the Government of Nepal (Ministry of Agriculture and Livestock) targeting farmers. The implementation period runs from 2014 to 2026.
[34] Total production was 11,500,000 (kg/year) in 2023, versus 5,500,000 (kg/year) in 2002. (Source: Junar Central Cooperative Union ltd.)
[35] The Sindhuli District meets climatic and geographical conditions suitable for Junar production (high altitude, large daily temperature differences, and long hours of sunlight).

- The opening of the Sindhuli Road has enabled farmers to access a wider range of markets and supply their produce according to demand. This has resulted in increased income, as farmers have strategically selected markets with higher selling prices and sell their products at higher prices. (Source: Municipal officials and residents of Khurkot)

Increased Traffic of Goods and People and More Job Opportunities

- The opening of the Sindhuli Road has increased the number of stores in the areas along the road. The road has made Bhakunde Besi a connecting point between several municipalities and a hub for the buying and selling of agricultural products. Commercial activity has been stimulated and employment opportunities have increased. (Source: Municipal official of Bhakunde Besi)
- A restaurant and guesthouse were opened along the Sindhuli Road two years ago, which has increased income. (Source: Resident of Nepaltok)
- Since the opening of the Sindhuli Road, businesses from other areas have been entering the area and commercial activities have been revitalized. (Source: Municipal official in Khurkot)
- Since the opening of the Sindhuli Road, Bardibas has become a transit point for the transportation of goods, which has stimulated commercial activities. (Source: Residents of Bardibas)

<Social Development>

Improved Access to Education

- The opening of the Sindhuli Road has improved access to education for children (Source: Residents of Bhakunde Besi, Nepaltok, Khurkot, Sindhuli Madi, and Bardibas).
- The Sindhuli Road has improved access to other areas, allowing children to attend schools in Kathmandu and Dhulikhel and receive a higher quality of education. (Source: Residents of Bhakunde Besi)
- Since there were no roads 10 years ago, children from other areas could not come to Bardibas. Today, however, they can commute to school in Bardibas by school bus. (Source: Residents of Bardibas)

Improved Access to Medical Care

- The opening of the Sindhuli Road has improved access to medical care. (Source: Residents of Bhakunde Besi, Nepaltok, Khurkot, Sindhuli Bazar, and Bardibas)
- The opening of the Sindhuli Road has made it possible to call an ambulance in the event of an emergency. Medical facilities have also increased, and the area has become a center for medical services. (Source: Residents of Bhakunde Besi)
- Ten years ago, when there was no local hospital, people had to travel to Janakpur to receive

medical attention. In the case of a serious illness, one had to fly further, from Janakpur to Kathmandu, and the flights were sometimes delayed or cancelled due to bad weather conditions. By the time of the ex-post evaluation residents were able to drive to Kathmandu, and thus had improved access to medical services. (Source: Residents of Bardibas)

[Column] Satellite Data Analysis

Furthermore, this ex-post evaluation used satellite data to verify whether the Sindhuli Road development has led to economic development in the towns along the Sindhuli Road.

Data Used

Nighttime light data was used as a proxy variable for economic development. A high correlation between nighttime light and economic development (economic growth rate) has been observed. As the economy develops and urbanization increases, the brightness of nighttime light tends to increase. There is a risk, however, that nighttime light alone fails to accurately capture this development, as the Sindhuli Road is in an area where agriculture is a major industry. Therefore, urbanization[36] and population were also used as indicators, in addition to nighttime light.

Analysis Method

A spatial and time-series method was applied to examine the extent to which the actual values of each indicator (nighttime light, urbanization and population) have changed in the project area (towns along the Sindhuli Road). Specifically, we spatially visualized the change in each indicator from before the project started to the year when the latest data was available[37]. Furthermore, we hypothesized that if the actual value of each indicator increases closer to the center of each town, the Sindhuli Road can be judged to have contributed to the economic development of that town. To test this, we divided the area within a 5 km radius of each town center into 1 km increments and visualized the changes in the actual values across these zones.

Analysis Results

<Nighttime light>

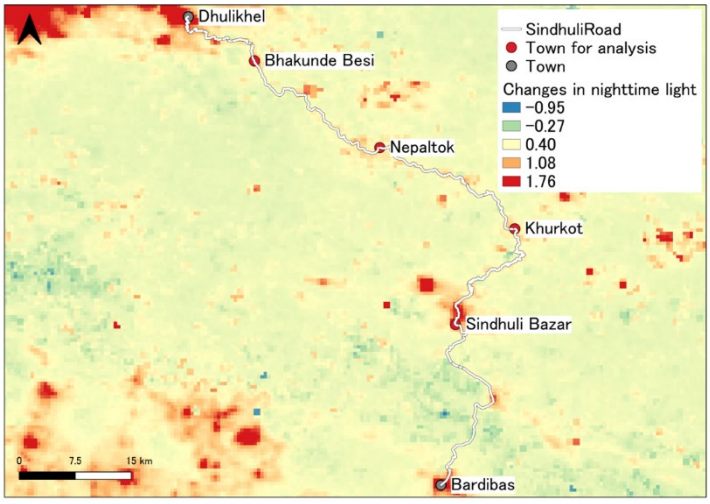
While this project involves rehabilitation work at specific locations along the Sindhuli Road, economic development is intrinsically linked to the entire route. Therefore, we investigated

[36] As an indicator of urbanization, we used the percentage of buildings. Using a land use map, the number of pixels of buildings was extracted. A pixel is the smallest unit that composes an image, and each pixel represents a specific area of the earth's surface. For example, if the resolution of an image acquired by a satellite is "30 m," one pixel represents a 30 m square area of the earth's surface. Each pixel is generally assigned a value for reflectance or radiation intensity for each wavelength.

[37] Data for nighttime light was used from 2014 to 2023, data for urbanization was used from 2016 to 2023, and data for population was used from 2014 to 2022.

whether traffic along the full length of the Sindhuli Road, including the project areas, has stimulated economic revitalization in the towns situated along its road.

Figure 8 visualizes the changes in the nighttime light surrounding the Sindhuli Road between 2014, before the project started, and 2023, when the ex-post evaluation was conducted. Compared to 2014, the nighttime light in the towns along the Road was increased in 2023. In particular, Dhulikhel, Sindhuli Bazar, and Bardibas showed significantly greater increases in nighttime light compared to the other towns.



Source: VIIRS Stray Light Corrected Nighttime Day/Night Band Composites Version 1

Figure 8: Change in nighttime light surrounding the Sindhuli Road (2014 vs. 2023)

Figure 9 shows the change in nighttime light (comparing 2014 and 2023) within a radius of 1 km, 2 km, 3 km, 4 km, and 5 km from the center of each town. In all of the towns but Nepaltok, the nighttime light increased as the proximity to the town center increased. The change within 1 km from the town center was the largest in Sindhuli Bazar.

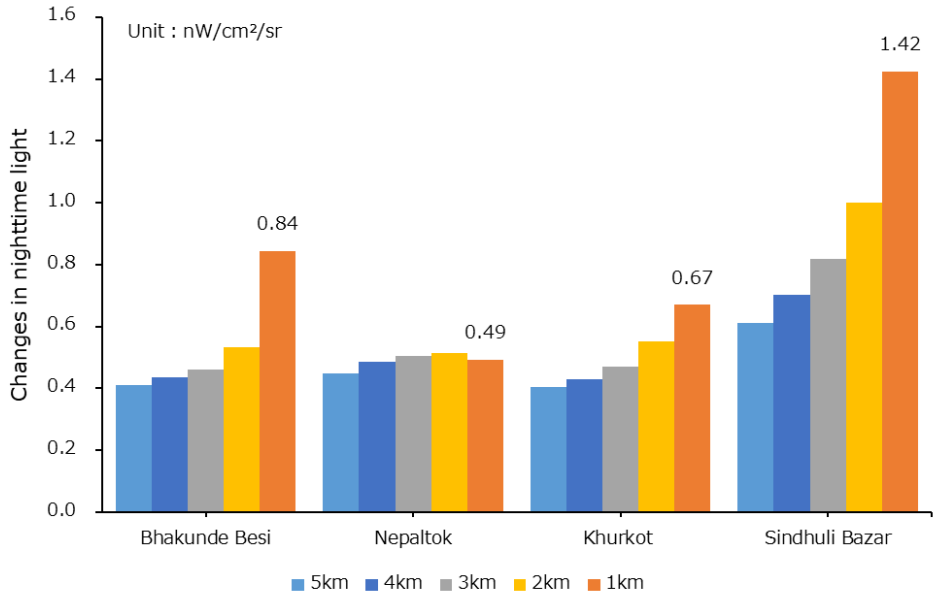
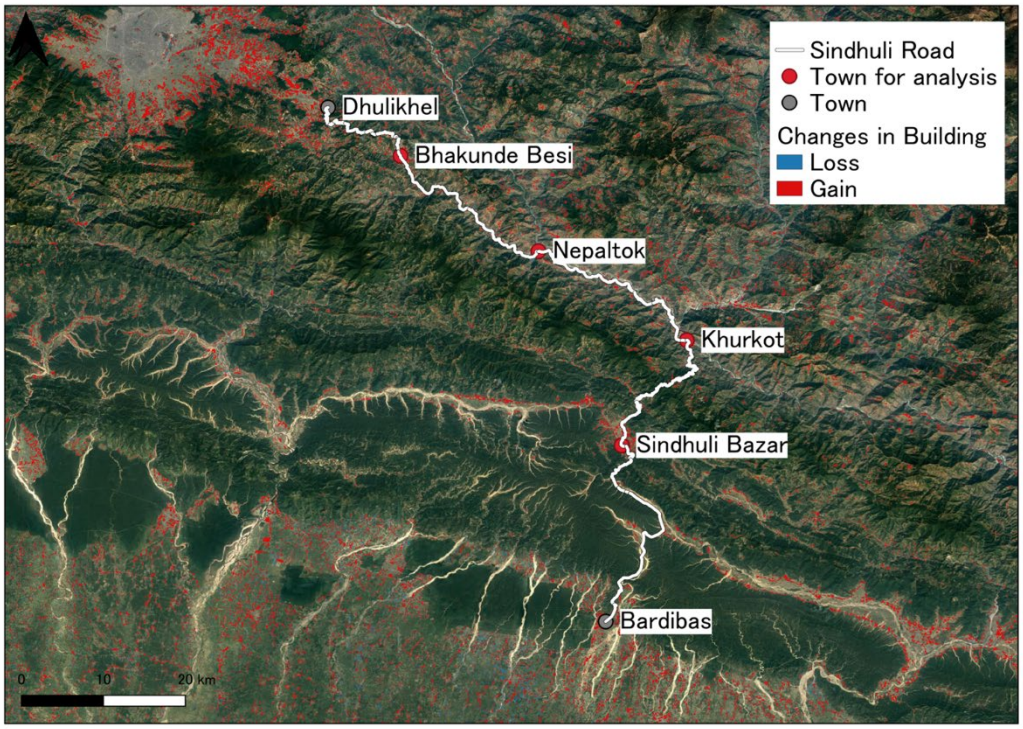
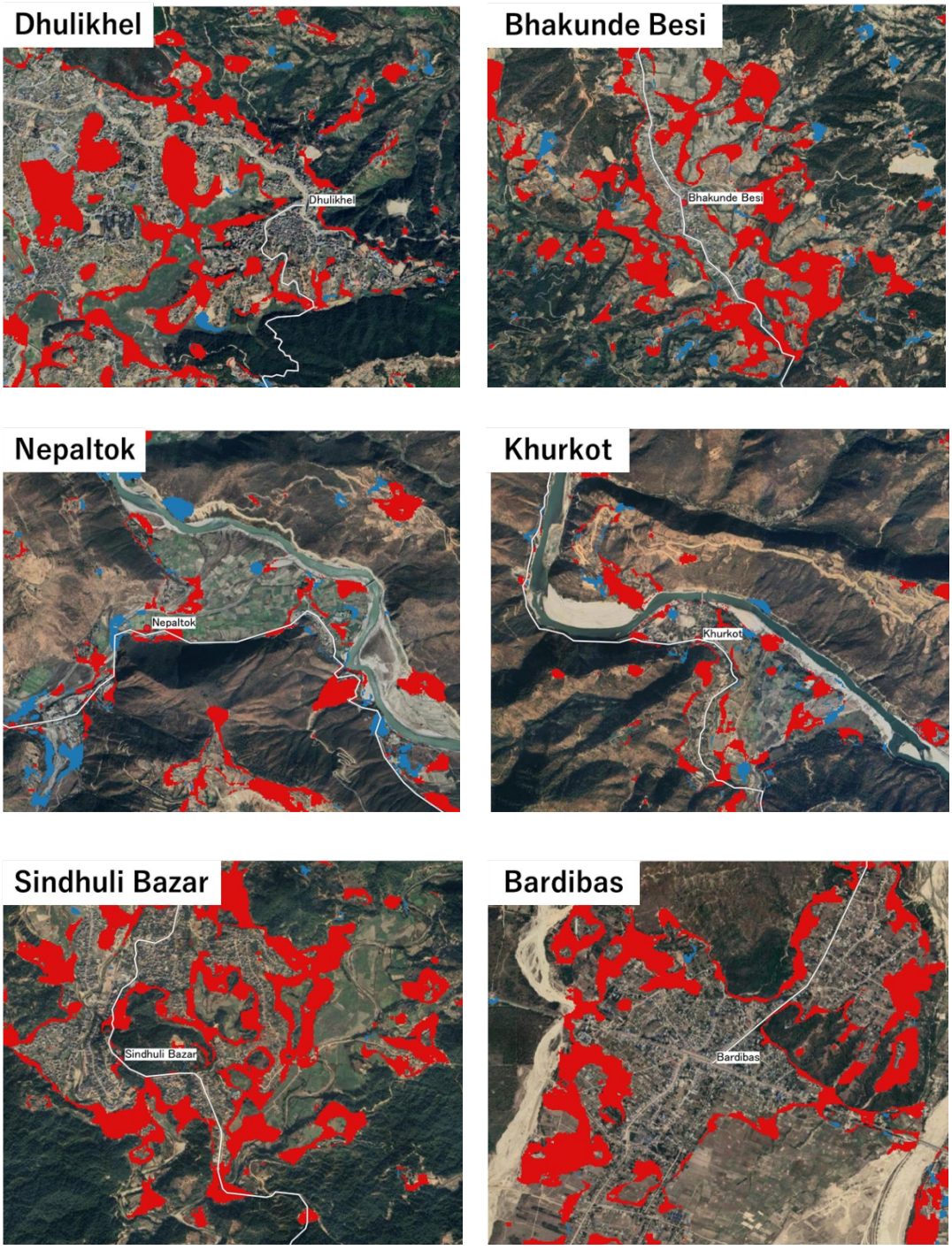


Figure 9: Changes in nighttime light and differences in the changes based on the distance from each the center of each town

<Urbanization>

Figure 10 visualizes the changes between 2016 and 2023 in the building footprints surrounding the Sindhuli Road. There has been a significant increase in the building footprints, especially around the towns of Dhulikhel, Bhakunde Besi, Sindhuli Bazar, and Bardibas.





Source: Dynamic World V1 for changes in buildings; the background map is a satellite photo (Google Satellite[38])

Figure 10: Change in the building footprints surrounding the Sindhuli Road (2016 vs. 2023)

Figure 11 shows the changes between 2016 and 2023 in the percentages of building footprints

[38] This service provided by Google displays satellite photos of the earth's surface.

within 1 km, 2 km, 3 km, 4 km, and 5 km radiuses of the center of each town. The greatest increase in the percentage of building footprints was observed within 1 km of the town center in each town.

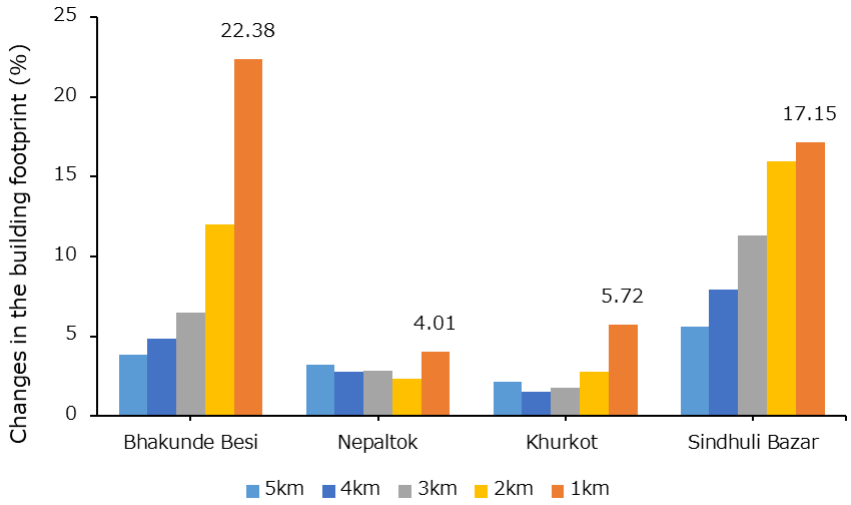


Figure 11: Changes in the building footprint and differences in the changes based on the distance from each the center of each town

We also examined what land was converted to buildings in each town along the Sindhuli Road. Figure 12 shows the change between 2016 and 2023 in the number of pixels of agricultural land, shrubs, and forest that were converted to building footprints within a 1 km radius of the center of each town. Due to the different land use conditions in each town, there has been variation in the types of land that have been converted to buildings. While forests were the land type most frequently converted to building footprints in Sindhuli Bazar, interviews with municipal officials indicated that trees were cut down on private land where logging was permitted due to prohibitions against logging in forest reserves. We also confirmed that forests were the land type most frequently converted to buildings along other roads not covered by the project (Arniko road (see Figure 2)).

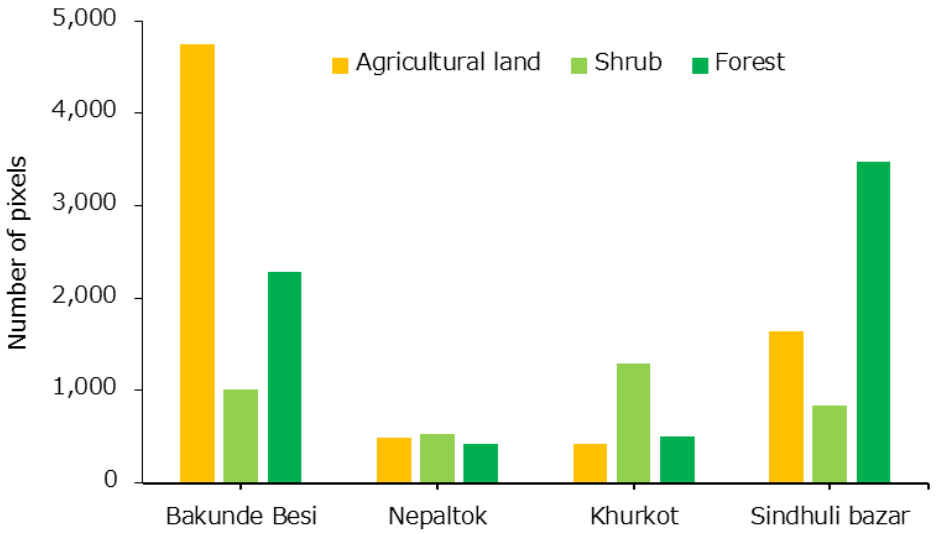


Figure 12: Type of land use that has changed to building footprints within a 1 km radius of the center of each town

<Population>

Figure 13 shows the change in population within a 1 km, 2 km, 3 km, 4 km, and 5 km radius of the center of each town. Population has been declining in all the towns. As the downward trend of population was observed even before the start of this project, factors other than this project itself are the likely drivers of the trend. According to project officials, an increasing number of people were seeking to move to Kathmandu in search of more opportunities. Data and resource constraints, however, made it difficult to further analyze the factors contributing to the population decline in this ex-post evaluation.

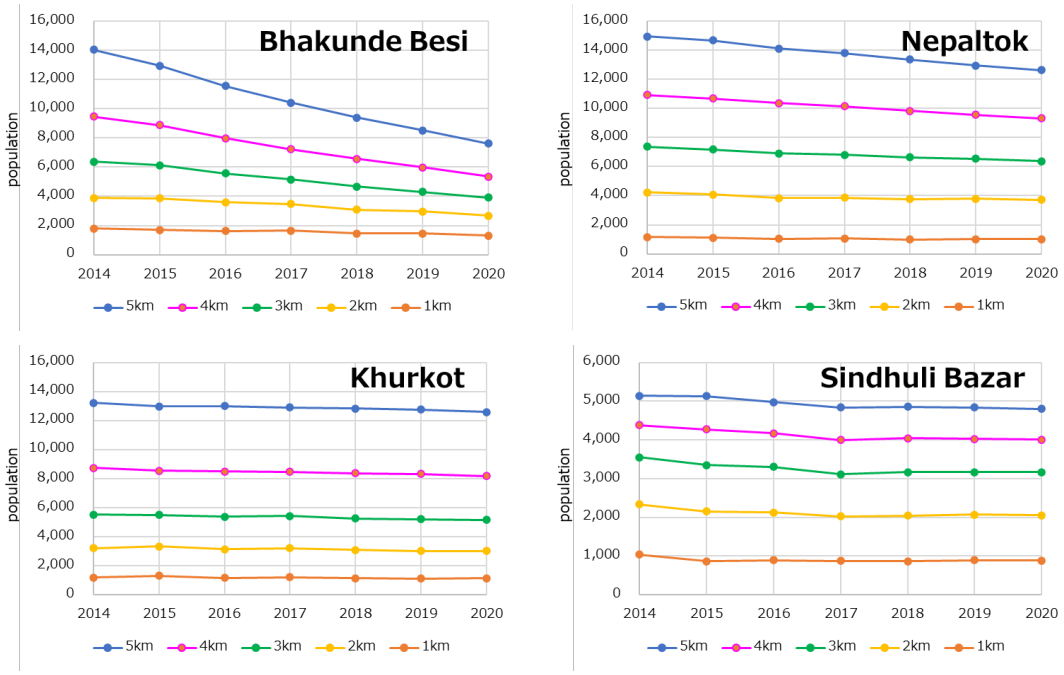


Figure 13: Population change and differences by distance from the center of each town

Conclusion

While the downward population trend in the towns along the Sindhuli Road, the nighttime light and numbers of building footprints at the time of the ex-post evaluation had both increased from the levels before the opening of the road. The increases, moreover, were greater at closer proximities to the centers of the towns along the road. Therefore, though the contribution to this trend by the project itself could not be confirmed, we can judge that the development of the Sindhuli Road, including this project, has contributed to the economic development of the towns along the road. Although deforestation was observed in the towns along the Sindhuli Road, the direct relationship between the project and deforestation was also unverifiable, and hence was excluded from consideration in the evaluation.

3.3.2.2 Other Positive and Negative Impacts

1) Impacts on the Environment

The project was determined not to fall into the large road sector listed in the *JICA Guidelines for Environmental and Social Considerations (April 2010)*, and the undesirable effects on the environment were not considered to be significant. The project was also judged to fall into Category B, as it did not encompass sensitive characteristics or sensitive areas listed in the same guideline. The *Initial Environmental Impact Assessment Report* was approved by the Ministry of Public Infrastructure and Transport in September 2018.

During construction, the environmental impact mitigation measures assumed at the time of planning were implemented. Environmental monitoring during project implementation included visual inspection of exhaust gas and dust; confirmation of the water quality and waste, oil and fuel leaks; noise and vibration measurements, infectious disease monitoring; and social environmental considerations. According to the environmental monitoring report [39], environmental mitigation measures were fully implemented, and no negative environmental impacts were identified. The project stakeholders also responded that no negative environmental impacts were identified during construction[40]. No complaints were received from surrounding residents[41].

DOR was conducting environmental monitoring through visual inspections at the time of the ex-post evaluation. Though no environmental monitoring reports were prepared, DOR stated that mitigation measures had been complied with and that no negative environmental impacts had occurred.

[39] Provided by the implementing consultant.
[40] Source: Questionnaire responses from the implementing consultant and from DOR.
[41] Source: Questionnaire responses from DOR

2) Resettlement and Land Acquisition

No resettlement or land acquisition took place under this project.

3) Gender Equality, Marginalized People

Improved access to education, vegetable cultivation, dairy farming, and health centers stemming from the improved access to transportation achieved under this project has promoted women's activities. In addition, the increased commercial activity along the Sindhuli Road has increased employment opportunities for vulnerable people[42].

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

In this ex-post evaluation, residents living in the area surrounding the Sindhuli Road were asked if they were satisfied with their lives compared to before the road was opened. If they responded that they were satisfied, they were asked what was involved in the change in their level of satisfaction. Some of the surrounding residents interviewed felt that the road had improved their access to markets, increased their income, and increased their choice of products. Accordingly, they perceived the road to be convenient and a source of greater happiness. Some responded that the opportunity for their children to receive a better education also contributed to their happiness.

5) Unintended Positive / Negative Impacts

Impact on an Agricultural Project

PMAMP currently provides pesticides, farm equipment, and irrigation subsidies to 300 agricultural cooperatives. The production of Junar, the main commodity sold in Sindhuli District, had increased by 40% at the time of the ex-post evaluation compared to three years before. With the increase in production came an increase in sales, and farmers began to earn more profit. Without the Sindhuli Road, it would have been difficult to initiate the project in view of the time and expense the PMAMP staff would have needed to spend to visit the farmers to be assisted[43].

Interviews with municipal officials and residents confirmed that the development of the Sindhuli Road has revitalized economic activity along the road and improved access to education and medical care. Satellite data analysis also confirmed that both the nighttime light and building footprint around the Sindhuli Road at the time of the ex-post evaluation had increased from the levels before the road was opened, and that the increases were more pronounced in the areas closest to the town centers along the road. Therefore, we judge that the development of the Sindhuli Road has contributed to the economic and social development of the towns along the road.

[42] Source: Questionnaire responses rom DOR

[43] Source: Interviews results to the PMAMP office director and staff.

As described above, this project has mostly achieved its objectives. Therefore, effectiveness and impact of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Policy and System

The *Annual Road Maintenance Program* published annually by the Roads Board Nepal stipulates road maintenance activities. The maintenance of Nepal's roads, including the Sindhuli Road, are to be conducted according to this program, and the maintenance of the Sindhuli Road is guaranteed by the program's existence[44]. The above suggests that maintenance activities on the Sindhuli Road are likely to continue in the future.

3.4.2 Institutional/Organizational Aspect[45]

As in the planning phase, DOR was responsible for the maintenance of the national roads in Nepal at the time of the ex-post evaluation. The overall management of the Sindhuli Road is carried out by the Sindhuli Road Maintenance Unit (hereafter referred to as "SRMU") of the Foreign Cooperation Branch of DOR. The project manager is in overall charge, and the Sindhuli Road Management Team (1 senior engineer, 4 engineers, 6 sub-engineers, 10 supervisors, and 53 workers) is under the supervision of the manager. There were no problems with the maintenance of the Sindhuli Road stemming from a lack of personnel at the time of the ex-post evaluation.

On the other hand, one of the supervisors involved in the project who received guidance from the consultant on maintenance methods is scheduled to be transferred. While the training center of DOR is conducting training on road maintenance methods, none of the training is focused on anchor construction. It will therefore be necessary to ensure that the supervisor steadily transfers the anchor construction maintenance methods to a new supervisor before the former transfers to a new position.

3.4.3 Technical Aspect

The duties and required qualifications (degrees) of each staff person responsible for the operation and maintenance of the Sindhuli Road are shown in Table 9. The staff persons have the required degrees and should have no problems performing their duties. Workers assigned to each 3-kilometer-long road section[46] perform daily inspections (cleaning, shoulder repair, dent repair, etc.) about three times a month and require no special skills to do so. In addition, since the supervisor provides guidance and supervision to the workers, no technical problems were found in the performance of the above daily inspections. A manual on how to perform the inspections is

[44] Source: Questionnaire responses from DOR
[45] Source: Final Report on the Data Collection Survey on the Sindhuli Road Capacity Enhancement in Nepal; Questionnaire responses from DOR.
[46] Surrounding residents employed by DOR.

also in place and referred to during the inspections[47].

Table 9: Description of Work and Qualifications

Position	Area of responsibility	Qualification
Senior Engineer/Engineer	Civil works, procurement of goods and consulting services (e.g., reviewing quotations, preparing bids and contracts, evaluating bids), site supervision, checking purchase orders, etc.	Bachelor of Civil Engineering
Sub-engineer	On-site supervision of civil engineering work, preparation of estimates, reviews of purchase orders and contracts, forwarding to engineers, etc.	Civil Engineering Diploma
Supervisor	Guidance and supervision to workers, monitoring of road conditions, and reporting of problems to engineers and sub-engineers as they arise.	Graduation from high school
Worker	Cleaning of roads, drainage ditches, traffic signs, and roadsides, removal of compost, weeding, and dent repair	Nothing in particular

Source: Questionnaire responses and interview results with DOR

3.4.4 Financial Aspect

At the time of ex-post evaluation, the maintenance budget for the Sindhuli Road consisted of two sources of funding: the Nepal Road Fund (hereafter referred to as "NRF")[48] and the Government of Nepal (hereafter referred to as "GON")[49]. Table 10 outlines the maintenance budgets for the Sindhuli Road in FY 2016/17 and in FY 2021/21 through FY 2023/24. Though the budget has been on a downward trend since FY 2021/22, it remains well above the estimated required cost for the maintenance of the facilities covered by this project at the time of planning, namely, NPR 16,720,000/year[50]. Additionally, it was confirmed during the field survey that no repairs were needed at that time[51].

Table 10: Maintenance Budget for the Sindhuli Road

(Unit: thousand NPR)

	2016/17	2021/22	2022/23	2023/24
NRF	14,180	51,466	21,738	14,853
GON*1	10,132	63,000	50,040	43,100
Total	24,312	114,466	71,778	57,953

Source: Questionnaire responses from DOR

*1: Loan

[47] Source: Questionnaire responses from DOR

[48] The maintenance costs of Nepal's roads are paid from a specific financial resource based on the Road Fund Act passed in 2002. The financial resources include taxes on fuel and vehicle registration, and tolls on specified roads, which are administered by the Nepal Road Fund. (Source: *FY2015 External Ex-post Evaluation Report, "The Project for Construction of Sindhuli Road (Section 2 (Phase3/3) and Section 3)*)

[49] Source: JICA documents

[50] Source: Preparatory Survey Report

[51] Source: Questionnaire responses from DOR

According to DOR, however, the above budget was not sufficient to cover the costs for an overlay of the entire Sindhuli Road, an operation that needs to be conducted every five years[52]. The most recent overlay was conducted in 2021; hence the next one needs to be conducted in 2026. DOR pointed out that if the need for an overlay arises, funds available from the World Bank could be used. As it happened, DOR added, the overlay of the Sindhuli Road conducted in 2021 was funded by the World Bank budget[53]. In addition, more revenue could be obtained by resuming the collection of the tolls[54] first established on the Sindhuli Road before the COVID-19 pandemic, though the total amounts collected would be modest.

Although the current budget is insufficient for conducting future overlays, it is considered that there are no serious financial issues, as funding from the World Bank is expected to be available.

3.4.5 Environmental and Social Aspect

As described above in "3.3.2.2 Other Positive and Negative Impacts.", no major negative environmental or social impacts have occurred by the time of the ex-post evaluation. Additionally, during the field survey, no potential future negative environmental or social impacts were reported.

3.4.6 Preventative Measures to Risks

There was a period during the spread of COVID-19 when no maintenance work could be conducted on the Sindhuli Road. Though maintenance works were completely suspended during the total lockdown period, they were conducted during the partial lockdown period. In addition, traffic on the Sindhuli Road was affected by flooding (July 2022 and June 2023), though measures such as river revetment work and periodic cleaning of debris were taken[55].

3.4.7 Status of Operation and Maintenance

The ex-post evaluation confirmed that there were no major deformations in the target areas and no major repairs required[56]. Visual inspections of the crib work and high-intensity nets were conducted once a week or every two weeks. For the road surface, an overlay was performed while the project was underway (2021). As road surface conditions have yet to merit it, no overlay has been conducted since that time[57].

For the anchor works, on the other hand, the maintenance methods in Table 11 were assumed at the time of planning. The frequency of inspections was assumed to be once a year for regular inspections plus extraordinary inspections to address abnormalities after heavy rains, etc.

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[52] Source: Preparatory Survey Report
[53] We inquired with DOR regarding specific project names and schemes but were unable to obtain a response.
[54] We inquired with DOR regarding the established toll fees but were unable to obtain a response.
[55] Source: Questionnaire responses from DOR
[56] Source: Visual confirmation by the field survey and interview results with DOR
[57] Source: Interview results with DOR

Table 11: Maintenance Methods for Anchor Works Assumed at the Time of Planning

Contents
Confirmation of weight by load gauge
Visual inspection
Anchor pop-out or not
Head cap deformation
Rust-preventive oil leakage
Deformation and settlement of pressure receiving plate
Presence of spring water
Surrounding subsidence, displacement, etc.

Source: Preparatory Survey Report

Visual inspections had been conducted once a year and during heavy rainfall at the time of ex-post evaluation. No weight confirmations using a load gauge, however, were performed[58]. Though no problems have occurred as of this time, the defect inspection results stated that, "load gauge observations installed on Sta. 17+400 shall be conducted once a month. (If no load reduction is observed for one year, the frequency of observation shall be once every six months)." On this basis, we recommend that load gauge observations be conducted.

While slight problems with the financial aspects of the project have been observed, there are good prospects for improvement. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was implemented aiming to the traffic safety of road users by rehabilitating the Sindhuli Road damaged by the Nepal Earthquake in 2015, thereby contributing to social and economic development. This project is consistent with the development plan and development needs of Nepal at the time of planning and the ex-post evaluation. This project is also consistent with the Japan's ODA policy at the time of the ex-ante evaluation. Although collaboration with other organizations was not implemented, the capacity of the staff responsible for maintaining the Sindhuli Road has been strengthened and the improvements to the Sindhuli Road and the implementation of traffic safety measures were conducted through collaboration with other JICA projects. These collaborations have contributed to achieving the project's outcome of ensuring "traffic safety for road users." Therefore, the relevance and coherence are high. Both the project

[58] Load results were reported to the implementation consultant for the first two years after completion. However, since there were no problems, it was determined that no further load verification was necessary, and no further load verification was conducted. (Source: Questionnaire responses from DOR and interviews results to SRMU staff)

cost and project period were within the plan, and the efficiency is very high. The quantitative (increase in the number of passengers) and qualitative (improved resilience against disasters and a reduction of roadblock losses) effects set at the time of planning were confirmed to have been achieved. Furthermore, based on interviews with municipal officials and residents and satellite data analysis, the development of the Sindhuli Road is judged to have contributed to social and economic development. Therefore, the effectiveness and impact are high. Regarding sustainability, there are slight problems with the financial aspects of this project, but they are not considered to be serious. Therefore, the sustainability of the project effects is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Maintenance of Anchor Work: As was recommended during the defect inspection, DOR staff should be aware that the load gauge observation installed at Sta. 17+400 should be conducted once a month (if no load reduction is observed for one year, the frequency of observation should be once every 6 months). To ensure that the staff who was involved with this project and has received guidance from the implementing consultant on maintenance methods can steadily take over when the staff personnel is transferred, a manual summarizing the above maintenance methods should be prepared and workshops should be held to introduce the anchor work maintenance methods to the other staff persons.

4.2.2 Recommendations to JICA

Regarding the anchor work, this project has provided guidance and a manual on how to use load gauges. Moreover, if another manual systematically outlining how to maintain anchor work (not only daily inspections, but also future detailed inspections and repairs) are provided, along with training based on the manual, the sustainability of the facilities developed in the project will be enhanced. Though the DOR training center is conducting training on how to maintain and manage the roads, no training on anchor work is offered. JICA could address this issue by dispatching Japanese experts to the training center to train personnel on anchor work and compile manuals. We propose that the JICA Nepal Office periodically check with DOR on the monitoring of the Sindhuli Road and the anchor work developed by the project and consider conducting the above-mentioned training and other activities.

4.3 Lessons Learned

When Introducing Japanese Technology, the Development of an Accompanying Manual is Desirable.

Regarding the anchor work, this project provides guidance and a manual. However, a manual

systematically outlining how to maintain anchor work (not only daily inspections, but also future detailed inspections and repairs) is not prepared. Since there is a limit to what can be implemented with the capacity training under the grant aid, we recommend that a separate Japanese expert be dispatched or that a manual be developed in collaboration with other schemes such as technical cooperation projects if requested by Nepal. There is a risk that the handover will be insufficient, particularly in developing countries where transfers are frequent. This makes it all the more important to have manuals in place for the guidance of new staff persons and others as needed.

5. Non-Score Criteria

5.1 Performance

5.1.1 Objective Perspective

None

5.2 Additionality

None

(End)