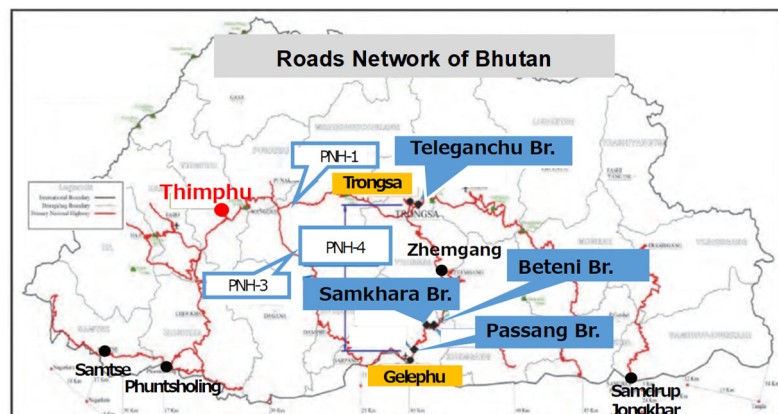


Country Name Kingdom of Bhutan	<b>The Project for Reconstruction of Bridges on Primary National Highway No. 4</b>
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Location of the Project site  
(Source: Information provided by JICA<sup>1</sup>)



Samkhara Bridge  
(Source: Photo taken by the evaluator)

## I. Project Outline

Background	In Bhutan, the majority of the national land is mountainous, and road transport is the most important means of transportation. Bhutan's road network consists mainly of the national highway network, with a total of five primary national highways; one east-west (Primary National Highway No.1 (PNH-1)) and four north-south (PNH-2 to PNH-4 and Asian Highway (AH 48)). The Primary National Highway No. 4 (PNH-4) <sup>2</sup> , the target of this project runs southward from Trongsa, about halfway along PNH-1, to Gelephu on the Indian boarder. A national project, the Mangdechu Hydroelectric Power Plant, was under construction along the route. PNH-4 plays an important role in facilitating the construction of the power plant and promoting Bhutan's economic growth. On the other hand, most of the bridges on PNH-4 were constructed before 1980s and many became old, damaged, and did not meet Bhutan's current design standards for both width and load capacity.			
Objectives of the Project	The objective of this project is to ensure stable traffic by reconstructing four bridges (Teleganchu Bridge, Beteni Bridge, Samkhara Bridge and Passang Bridge) in Trongsa and Sarpang districts and improving performance and safety of these bridges, thereby contributing to the promotion of regional economic revitalization and improvement of living conditions in rural areas.			
Contents of the Project	<ol style="list-style-type: none"> <li>1. Project Site: Trongsa District (Teleganchu Bridge) and Sarpang District (Beteni Bridges, Samkhara Bridge and Passang Bridge)</li> <li>2. Japanese side: 1) Construction Works: Reconstruction works of the four bridges on PNH-4 (including slope protection works and foot paths), and construction of approach roads, 2) Consulting Services: Detailed design, bidding assistance, and construction management</li> <li>3. Bhutan side: Construction-related: Removal and relocation of obstructing objects that affect construction works, provision of land for soil disposal sites and construction waste disposal sites, relocation and installation of electricity, water, drainage, and other ancillary facilities to the vicinity of the site Others: Exemption from customs duties and clearance fees for imported products, application for and approval of environmental clearance, removal of the existing Teleganchu Bridge and detour road of Beteni bridge within three years after the project, etc.</li> </ol>			
Implementation Schedule	E/N Date	December 16, 2016	Disbursement Date	
	G/A Date	December 26, 2016	Completion Date	December 15, 2000 (Handover Date)
Project Cost	E/N Grant Limit / G/A Grant Limit: : 2,156 million yen, Actual Grant Amount: 2,133 million yen			
Executing Agency	Department of Roads, Ministry of Works and Human Settlement: DoR <sup>3</sup>			
Contracted Agencies	Main Contractor(s): Dai Nippon Construction Main Consultant(s): Oriental Consultants Global Co., Ltd./INGEROSEC Corporation (JV)			

<sup>1</sup> The map is processed from information provided by JICA.

<sup>2</sup> PNH-4 was renamed PNH-5 at the time of ex-post evaluation, following the restructuring of the national highway network in 2020. However, in this report, PNH-4 is used as it was at that time.

<sup>3</sup> In December 2022, due to the reorganization of ministries, the executing agency was renamed the Department of Surface Transport, Ministry of Infrastructure and Transport. However, this report uses the name as it was then.

## II. Result of the Evaluation

### Summary

The project aimed to ensure smooth traffic by reconstructing four bridges on Primary National Highway No.4 and improving bridge performance and safety, thereby contributing to the promotion of local economic revitalization. In Bhutan, road traffic is the most important means of transportation and PNH-4 leading to southern part of the country is one of the most important trunk roads. This objective, therefore, was consistent with the policies and needs of the country at the time of project planning. The project plan and approach were appropriate, emphasizing safety aspects such as consideration for people who are vulnerable to traffic accidents and measures to protect cut surfaces. Although specific collaboration with non-JICA projects was not planned, the project was in line with ODA policy of Japan. In addition, the project collaborated with other JICA projects, and concrete results were confirmed. Therefore, relevance and coherence are high. Outputs were delivered mostly as planned. Both the project cost and the project period were within the plan. Therefore, the efficiency is very high. The quantitative effect indicators set at the time of planning mostly achieved their goals. Based on the interviews conducted to the executing agency and bridge users, it was confirmed that the project has ensured the safety of bridges, promoted logistics through stable transportation, and contributed to the revitalization of the local economy, each with concrete evidence. In addition, interviews with residents and users in the vicinity of the bridges also confirmed that the project has contributed to improving the living conditions of rural areas. Other impacts, such as contributing to the development of construction-related human resources in Bhutan, were confirmed. Based on the above, the effectiveness and impact are high. No issues have been observed in the policy/system, institutional/organizational, technical, financial, and environmental and social aspects, including the current status of operation and maintenance. Future risks have been well mitigated. Therefore, sustainability of the project effects is very high.

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

<b>Overall Rating<sup>4</sup></b>	<b>A</b>	<b>Relevance &amp; Coherence</b>	<b>③<sup>5</sup></b>	<b>Effectiveness &amp; Impacts</b>	<b>③</b>	<b>Efficiency</b>	<b>④</b>	<b>Sustainability</b>	<b>④</b>
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<Special Perspectives Considered in the Ex-Post Evaluation／Constraints of the Ex-post Evaluation>

None

### 1 Relevance/Coherence

#### <Relevance>

- Consistency with the Development Policy of Bhutan at the Time of Ex-Ante

The *Road Master Plan (2007-2027)* of Bhutan stipulates the implementation of road widening and maintenance/repair and reconstruction of bridges on national and district roads. *The 11th Five-Year Plan (2013-2018)* prioritizes the improvement of national road networks and access to the construction sites of hydroelectric power plants. The reconstruction of the four bridges of this project was included in the plan. The Mangdechu hydroelectric power plant construction project on PNH-4 was a national project. Improving the bridges on PNH-4 was a priority issue as a route to bring in materials and equipment needed for the project. Therefore, the project was in line with the Bhutan's development policies.

- Consistency with the Development Needs of Bhutan at the Time of Ex-Ante

As mentioned in "Background" above, PNH-4 is the one of major trunk roads in Bhutan transport network and the only arterial road with no alternative route between Trongsa in the central region and Gelephu in the south. However, most of the bridges on PNH-4 were aging, damaged and had insufficient load carrying capacity. There was an urgent need to improve the aging bridges in order to facilitate the smooth flow of materials and equipment for the construction of a national hydroelectric power plant project. The Bhutanese government had identified eight bridges on PNH-4 as priority bridges for reconstruction in its *11<sup>th</sup> Five-Year Plan*. Four of the bridges in this project were technically challenging due to their length, height of bridges, and surrounding topographical conditions, and required technical assistance from outside the country. Therefore, the project was in line with the development needs of the country at the time of planning.

- Appropriateness of Project Design/Approach

In the past ex-post evaluation for similar projects, the lesson learned was to take care to ensure that the bridge plan and maintenance plan fully take into account the executing agency's response capacity and current status regarding maintenance. In this project, maintainability was one of the criteria for selecting the bridge type, accessories, approach road, and revetment work. In addition, it was confirmed that lessons learned were taken into account in the design of the project, such as the fact that the basic maintenance and management of the bridge would not require major repair or reinforcement for 20 to 30 years, considering the organizational and financial capacity of the executing agency. Furthermore, the bridge reconstruction projects in Bhutan supported by Japan, including this project, were planned to protect cut surfaces with higher standards than those usually implemented by the Bhutanese government, thus enhancing safety in Bhutan, where landslides are common. In addition, on the Passang Bridge, which is located near a residential area and has many pedestrians, foot paths at both ends were constructed at the request of the executing agency. In this way, the project planned to ensure the safety of vulnerable road users such as children,

<sup>4</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>5</sup> ④: Very High, ③: High, ②: Moderately low, ①: Low

the disabled, and the elderly. Thus, the project plan and approach were appropriate, taking into consideration the lessons learned in the past and the ability of the executing agency to respond to the project, as well as the design that emphasizes consideration for vulnerable traffic and safety in the slope protection measures.

#### <Coherence>

##### ▪ Consistency with Japan's ODA Policy at the Time of Ex-Ante Evaluation

At the time of planning, the rolling plan for Bhutan states that assistance is provided for the development of road networks and bridges in order to secure efficient and stable transportation and to promote regional economic revitalization. In addition, JICA Country Analysis Paper for Bhutan (March 2013) identified road and bridge construction, which plays an important role in improving accessibility in rural areas, as a priority issue. Therefore, the project was in line with Japan's development cooperation policy at the time of planning.

##### ▪ Internal Coherence

The internal coherence with "Technical Cooperation Project for Capacity Development in Construction and Maintenance of Bridges" (September 2016 - April 2022) (hereinafter referred to as "CAMBRIDGE") was confirmed. Collaboration was achieved so that the construction site of the project would become a place for on-the-job training by CAMBRIDGE. DoR officers who are responsible for maintenance of the project received training courses provided by CAMBRIDGE to strengthen their capacities. Concrete synergistic effects were also observed, with the outcomes of CAMBRIDGE being used in the maintenance of the project such as utilization of bridge maintenance and inspection manuals developed under CAMBRIDGE.

##### ▪ External Coherence

No collaboration with other projects was envisioned, and no specific synergistic effects were identified.

#### <Evaluation Results>

In light of the above, the relevance and coherence of the project are high<sup>6</sup>.

## 2 Efficiency

### (1) Project Outputs

The project was to reconstruct four bridges, Teleganchu Bridge, Beteni Bridge, Samkhara Bridge and Passang Bridge and to construct approach roads as shown in Table 1. Foot paths were installed on Passang Bridge where many residents live near the bridge. The slope protection works were implemented on three bridges located in mountainous areas, except for the Passang Bridge<sup>7</sup>. The project outputs were generally as planned.

Table 1: Outputs

Bridge	Length (m)	Total Width (m)	Lane	Sidewalk	Approach Rd (m)*	Total width (m)
Teleganchu Bridge	42.0	14.704~12.220	3.5m x 2 Lanes		53.5+95.5	10.5
Beteni Bridge	30.0	9.909~8.836			81.0+99.0	
Samkhara Bridge	49.5	9.281~11.119			59.0+84.0	
Passang Bridge	41.5	11.140~11.181		1.5m x 2	49.5+50.0	

\* : Approach roads were constructed on both sides of the bridges. The number on the left are the distances closer to Trongsa and the numbers on the right are the distances closer to Gelephu.

Source: Results from the questionnaire to DoR

The design of the project was modified to address boulders on the slope of approach road of Samkhara Bridge discovered after the start of construction, and to restore and reinforce the slope of approach road of Teleganchu Bridge after its surface slope collapse due to higher-than-expected rainfall during the rainy season. However, those modifications did not affect the outputs. It was confirmed that the undertaking by the Bhutanese side were also carried out without delay. The former Teleganchu Bridge, which was scheduled to be removed within three years after the completion of the project, was not removed because it was to be used for other purposes by the Trongsa district, which has jurisdiction over the bridge. However, the executing agency and the on-site observation confirmed that there was no vehicle traffic and no particular safety issues.

### (2) Project Cost

The actual cost of the Japanese side was 2,133 million yen compared to the planned cost of 2,156 million yen, which was within the plan (99% of the plan). Although additional restoration and reinforcement works were implemented during the project period due to the above-mentioned boulder problems and the surface slope collapse, which were not anticipated. Those works fell under the category of "Unexpected Environmental Conditions, etc." and JICA approved the use of the contingency fund. Furthermore, a landslide occurred during the construction period in the area on PNH-4 (Ossey) between the material yard of Passang Bridge and Samkhara Bridge. The transportation of materials and equipment had to be detoured (originally planned distance of 26 km was extended to 500 km after the detouring). The cost of the detoured transportation was approved by JICA as a "Force majeure" and the use of the contingency fund was approved. The actual project cost on the Bhutanese side could not

<sup>6</sup> Relevance: ③, Coherence: ③

<sup>7</sup> Slope protection work was not implemented for the Passang Bridge because it is a bridge over flat land and has no slope.

be confirmed due to a lack of data from the executing agency.

### (3) Project Period

The planned period was 49 months, from December 2016 to December 2020. The actual period was 49 months, from December 2016 to December 2020. However, the construction was suspended approximately one month due to a lockdown order issued by the Bhutanese government during the outbreak of the new coronavirus infection. Since the suspension of construction was a force majeure event, one month was subtracted from the actual period to arrive at a 48-month. Therefore, the project period was within the plan (98% of the plan).

### <Evaluation Results>

Although there were unexpected problems during the project period such as the boulder problems, restore and reinforce construction due to the surface slope collapse, detouring of transportation routes and the suspension of construction due to the new coronavirus infection, both the project cost and project period were within the plan by utilization of contingency funds and improving efficiency of construction through parallel work. Therefore, the efficiency of the project is very high.

## 3 Effectiveness/Impacts<sup>8</sup>

### <Effectiveness>

#### (1) Quantitative Effects

The target values were achieved for average traveling speed, loading capacity, and annual average daily traffic for the four target bridges. The annual average daily traffic between Trongsa and Zhemgang increased significantly in 2020 and 2021, despite the corona period. This was due to the increase in the number of construction vehicles for the Mangdechu hydroelectric power plant in this area as well as the Nikachu hydroelectric power plant, whose construction began in 2016. The traffic volume dropped after construction was completed, but it still reached the target. On the other hand, the traffic between Zhemgang and Gelephu dropped in 2021. This was due to a sharp decrease in the number of vehicles entering Gelephu from India due to the close of the Indian boarder caused by the new coronavirus infection. However, since the border reopened in September 2022, traffic has steadily increased, far exceeding the target.

Annual average daily passengers and annual average daily cargo were not monitored by the executing agency. Although an attempt was made to estimate these indicators based on annual average daily traffic data, the estimated figures could not be simply compared to those in the plan since the baseline data was actually measured. Therefore, they were set as N/A.

#### (2) Qualitative Effects

The project was envision 1) “improving the safety of bridges and approach roads,” 2) “ensuring pedestrian safety by installing foot paths,” 3) “ensuring stable transportation and traffic,” 4) “revitalizing economy of Trongsa and Sarpang districts,” and 5) “improving the livelihood of rural areas.” The qualitative effects of 1) and 2) together with “improvement of safety” were confirmed through interviews with the executing agency, residents living near the bridges, and drivers using the bridges<sup>9</sup>, as well as through on-site inspections, as described below. 3), 4), and 5) were confirmed as impacts.

The project has enabled two-way traffic, the increased load capacity has allowed large vehicles to pass without having to unload once in front of the bridge, and the improved alignment between the approach road and the bridge has allowed large vehicles to safely pass through the bridge without having to turn around. It was confirmed by the Road Safety and Transport Authority in charge, executing agency and residents living near the bridges that no traffic accidents have occurred since the project was completed. Therefore, it can be concluded that the safety has been improved. In particular, many respondents mentioned that landslides and falling rocks, which used to occur around the bridges every year during the monsoon season, have never occurred since the completion of the project due to the implementation of the slope protection works by the project. It was confirmed that the project improved safety and enabled stable traffic. Furthermore, it was confirmed that the construction of foot paths on the busy Passang Bridge has created a psychological sense of security not only for pedestrians, but also for drivers, who can drive with peace of mind.

<sup>8</sup> When providing the sub-rating, Effectiveness and Impacts are to be considered together.

<sup>9</sup> Interviews were conducted with residents near the bridges, shop owners, taxi drivers, school and hospital personnel regarding changes before and after the project (total of 38 people were interviewed (men:26, women: 12 (7 people near Teleganchu bridge, 9 people near Beteni bridge, 6 people near Samkhara bridge, and 16 people near Passang bridge)).



## Quantitative Effects

Table 2: Comparison of Qualitative Effects Indicators Before and After the Project

Indicator		Baseline 2015 Planned Year	Target Year 2023 3 Years after completion	Actual 2020 Completion Year	Actual 2021 1 Year after completion	Actual 2022 2 Years after completion	Actual 2023 3 Years after completion
Average Travelling Speed (km/h)* <sup>1</sup>	Teleganchu	13	20	20	20	20	20
	Beteni	12	20	20	20	20	20
	Samkhara	14	20	20	20	20	20
	Passang	19	60	60	60	60	60
Loading Capacity (t)* <sup>2</sup>	All four bridges	55	100 * <sup>2</sup>	100	100	100	100
Annual Average Daily Traffic (vehicle/day)	Trongsa ~ Zhemgang	190	245	592	849	452	278
	Zhemgang ~ Gelephu	233	301	422	180	303	524
Annual Average Daily Passengers (passenger/day)	Trongsa ~ Zhemgang	640	826	N/A	N/A	N/A	N/A
	Zhemgang ~ Gelephu	785	1,014	N/A	N/A	N/A	N/A
Annual Average Daily Cargo (t/day)	Trongsa ~ Zhemgang	382	493	N/A	N/A	N/A	N/A
	Zhemgang ~ Gelephu	469	606	N/A	N/A	N/A	N/A

Source : Ex-ante Evaluation, Questionnaire and interview results from DoR

\*1: The values shown are based on field measurements of travel speeds in the section including the approach roads section (approximately 20 m on each side), because the approach roads alignment was poor for all four bridges at the ex-ante stage, and the speeds were slowed down to the point of pausing in front of the bridges.

\*2: The IRC standard (Indian design standard) was adopted for the design live load in this project, which indicates that a vehicle with a maximum total axle weight of 100 tons can pass through the target bridges.

### <Impacts>

#### 1. Intended Impacts

Regarding 3) and 4) set in the above qualitative effects, since 3) “ensuring stable transportation and traffic” leads to 4) “revitalization of the local economy (Trongsa and Sarpang districts),” the impact of the two together was confirmed as “revitalization of the local economy.” In addition, 5) “improvement of livelihoods in rural areas” was confirmed as follows.

##### 1) Revitalization of local economy

The conditions of bridges other than the project’s bridges on PNH-4 were also confirmed through interviews with the executing agency and on-site inspections, as these bridges also have an impact on ensuring stable transportation and traffic. As the results, although some bridges were one-sided traffic, all bridges have a load capacity of 40 tons or more, and there were no bridges that could serve as bottlenecks. In addition, it was found that according to Bhutan’s trade statistics, the percentage of imports entering from Gelephu, where PNH-4 connects to the Indian border, increased after the completion of the project compared to other major regions along the border (from 6.1% (2018) to 9.5% (2023)). This can be attributed to the improved accessibility of PNH-4, which is used as a means of transportation from Gelephu to central and eastern Bhutan. Since there are no bottleneck bridges on PNH-4 and the annual average daily traffic, effect indicator, has increased, it is considered that project has secured stable transportation and traffic, thereby revitalizing the local economy.

Furthermore, the Bhutanese government has launched a major plan to develop a special administrative district in Gelephu at the end of 2023, called the “Gelephu Mindfulness City” concept, to create a new economic center<sup>10</sup>. The widening of PNH-4 is also planned in the *13th Five-Year Plan (2024-2029)*. If this initiative centered on Gelephu goes into full swing in the future, Gelephu will become the second center of Bhutan and the impact of this project on revitalizing the local economy is expected to be even greater.

<sup>10</sup> The vision is to create not just a special economic zone, but a special administrative region in an area of over 1,000 km<sup>2</sup> in Gelephu along the Indian border, based on Bhutanese culture, Gross National Happiness Index (GNH) principles, and the country's strong spiritual heritage, blended with modern living. It aims to lay the foundation for the country's future growth and create economic opportunities for its people through investments in green technology, education, and infrastructure. The master plan includes a spiritual center, an international airport, railway connections, and a hydroelectric dam. (SPA Business, dated on 20 December 2023, <https://www.spabusiness.com/wellness-news/Bhutanese-King-unveils-Mindfulness-City-masterplan-for-Southern-Bhutan/352357>)

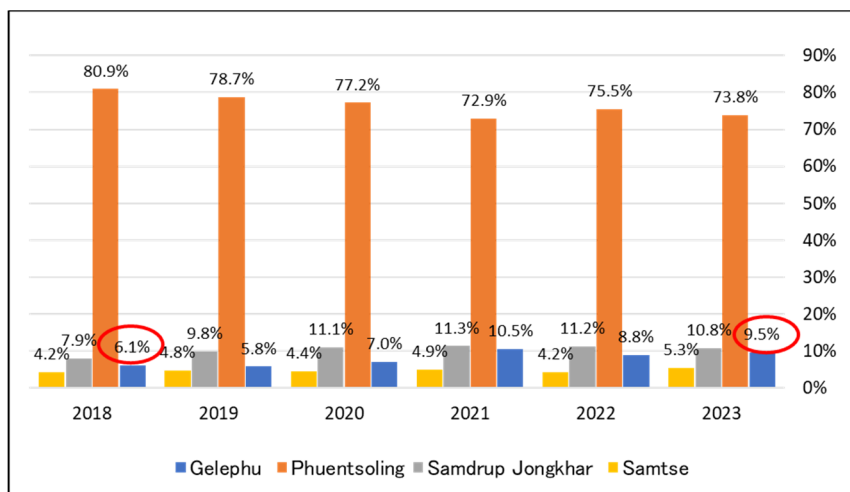


Figure 1: Percentage of Imports from the Four Indian Border Regions

Source: Prepared by the external evaluator from Bhutan Trade Statistics (each year)

## 2) Improvement of livelihoods in rural areas

From the interviews with owners of shops and restaurants and bridge users in the vicinity of the bridges<sup>11</sup>, many indicated that the increase in traffic has led to an increase in the number of customers, which in turn has led to increased income. In addition, residents near the bridges were employed as construction workers and clerks for the project, which increased their income and improved their skills. After the project, some respondents said that they could build their own houses, and some said that their income opportunities expanded such as through engaging necessary construction works for their villages. Prior to the project, it lacked convenience such as that the aging bridges was unstable, making it dangerous to pass through especially at night. In the event of a landslide, the bridges were closed to traffic until the debris was removed. Many of residents interviewed indicated that after the project these problems had disappeared and that access to a larger towns, hospitals, and schools had improved, with reduced travel times. In particular, hospital personnel said that ambulances and other emergency vehicles can now pass through without problems and can respond to emergency situations. From the above, it can be said that this project has contributed to a certain extent to improving livelihoods in rural areas.

## 2. Other Positive and Negative Impacts

### (1) Impacts on the Natural Environment

The project does not fall under the category of large-scale projects in the road and bridge sector listed in the JICA Guidelines for the Confirmation of Environmental and Social Consideration (April 2010). It was determined to fall under Category B because the undesirable environmental impact was judged to be insignificant and it does not fall within the sensitive characteristics and sensitive areas listed in the Guidelines.

Environmental clearance was granted prior to the start of construction (October 2017) (Beteni, Sarpang, and Passang bridges for January 2017, Teleganchu bridge for May 2017). According to the executing agency, during the construction, air pollution, water pollution, noise/vibration and waste were monitored as planned and appropriate measures were taken. After construction, DoR regional office in charge of the bridge has been monitoring noise, odor, etc. during bridge inspections, and confirmed that no particular problems have occurred so far. Based on the results of interviews with local residents, it was confirmed that there were no problems with the natural environment during and after the project.

### (2) Resettlement and Land Acquisition

Resettlement and land acquisition did not occur in this project.

### (3) Gender Equality, Marginalized People, Social Systems and Norms, Human Well-being and Human Rights

In this project, foot paths and guard rails were installed on both sides of Passang Bridge, where there are many pedestrians. In addition, it was confirmed that pedestrians, especially vulnerable people in traffic such as elderly and people with disabilities were taken into consideration, as the sidewalk entrances and exits are sloped with no steps.

### (4) Unintended Positive/Negative Impacts

#### <Development of local human resources in construction-related areas>

Several residents living near Beteni and Sarpang bridges were employed as construction workers by the Japanese contractor for this and past bridge projects of Japanese grant aid. According to them, a network had developed among these people who had been employed by the Japanese contractor in the past, and when any employment opportunity arose, they would be called upon and such information would be available through horizontal connections. In addition to income, the villagers employed by this project indicated that their construction skills had improved, and that they had all acquired “quality-oriented” and “safety-first” attitude. It was confirmed that these basic attitudes of the construction industry have been penetrated through employment by the Japanese contractor.

<sup>11</sup> Interviewees were the same as in footnote 9.

In addition, according to the executing agency, Japan's longstanding cooperation on bridges has improved the skills of DoR officers and other local contractors, which has improved the bridge construction techniques used in Bhutan's own projects. In fact, local contractors in Bhutan have gained skills and experience through Japan's cooperation, and are now able to implement important national projects other than bridges. Therefore, it can be said that not only this project but also the past Japanese bridge projects have contributed to the quality of construction and the development of related human resources in Bhutan.

#### <Reinforcement of sense of unity of the community>

Since many villagers were involved in the construction of the bridges, many said they were proud of them as bridges in their own villages, fostering a sense of ownership of the bridges. In addition, interviews with local residents also revealed that all of them responded that the project bridges are beautiful and that they have become familiar, with picnics held near the bridges. The bridges have become landmarks and a source of pride for local residents. Thus, it can be said that the project has contributed to a certain extent to strengthening the sense of unity of the local community.

#### <Evaluation Result>

This project has mostly achieved its objectives. Therefore, effectiveness and impacts of the project are high.

### 4 Sustainability

#### • Policy and System

According to the executing agency, the widening of PNH-4 has been planned in the *13th Five-Year Plan (2024-2029)*, although it has not been publicized at the time of ex-post evaluation. As mentioned above in "Impacts," the Bhutanese government has given high priority to the development of roads leading to Gelephu based on the King's "Gelephu Mindfulness City" concept. Therefore, the road network, including the bridges reconstructed by this project, continues to be of high importance. In addition, anticipating monsoon damage, a system is in place to allocate emergency response costs and repair costs according to damage to DoR regional offices every year. In light of the above, the policy and institutional sustainability have been ensured.

#### • Institutional/Organizational Aspect

There is no change in the roles of maintenance from the time of planning. Basically, the DoR regional office in the district where the bridge is located conducts routine inspections (cleaning, removal of sediment, etc.) and periodic inspections. The head office monitors the regional offices. The Maintenance Department of the head office inspects the condition of roads and bridges after monsoons and makes judgments on the necessity of repairs. Trongsa Regional Office is in charge of Teleganchu Bridge, and Sarpang Regional Office is in charge of Beteni Bridge, Samkhara Bridge and Passang Bridge. A certain number of civil engineers are stationed at the head office and each regional office, and the system is in place to handle emergency repairs. The cleaning of roads, including bridges, is carried out by Bhutanese workers (National Work Force (NWF)) registered with the executing agency. NWF is cleaning the roads in its assigned section, including bridges. From the above, it can be judged that there are no particular problems with the institutional/organizational aspects.

#### • Technical Aspect

Each Regional Office has a sufficient number of civil engineers (18 in Trongsa Regional Office and 22 in the Sarpang Regional Office) to handle maintenance and management, and they have the ability to perform maintenance of minor damage and emergency response. If there are technical problems, they can get advice from the engineers at the head office. The technical training is basically focused on OJT, but even after the completion of the CAMBRIDGE project, the DoR continues to improve technical skills through internal training programs. The bridge inspection manuals introduced in CAMBRIDGE are being used. Each regional office has inspected the condition of bridges under its jurisdiction and updated the information twice a year in a database (Bridge Management System<sup>12</sup>) connected to the head office for use in asset management. In addition, a routine-based maintenance plan<sup>13</sup> for the bridges introduced in CAMBRIDGE has been developed and the annual required amount has been submitted to the Bridge Division of the DoR head office for budgeting. There were three engineers in Trongsa Regional Office and 20 engineers in Sarpang Regional Office who had received training by CAMBRIDGE at the time of ex-post evaluation. Based on the above, there are no particular problems with the technical sustainability.

#### • Financial Aspect

The maintenance budget has been shrinking since 2020 as shown in Table 3 due to the impact of the new coronavirus infection and tight government finances, but the budget for routine maintenance and maintenance for minor damage has been secured. The overall maintenance budget for roads including bridges, has increased significantly since FY 2022 due to an increase in the maintenance budget for national highways, while the annual maintenance budget for bridges has remained unchanged at approximately 4 million Nu (approximately 7 million yen<sup>14</sup>) in recent years. According to the executing agency, with limited budgets, each regional office is devising ways to address bridges with high needs by prioritizing them and using the money saved through bidding to cover maintenance costs. In cases where serious repairs are needed, the budgets of other regional

<sup>12</sup> The system that monitors the conditions of bridges by inspecting them twice a year according to the guidelines and updating the information, which is useful for asset management. This allows the priorities for maintenance to be identified. However, according to DoR, it is not possible to produce unit costs for repairs because conditions vary by region even for the same damage. Therefore, the budget has not been calculated from the information in the Bridge Management System yet. Separate budget requests are made for bridges that require major repairs.

<sup>13</sup> Routine based maintenance plan is a budget plan for simple maintenances such as mowing the surrounding area, painting bridges, cleaning debris, etc., performed by the regional offices.

<sup>14</sup> 1 Nu = 1.76 Yen (August 2024)

offices can be passed on through the head office. In addition to the regular maintenance budget, 3 million Nu (approximately 5.3 million yen) is allocated to each regional office at the beginning of each year as a monsoon emergency response, and additional repair costs are added as necessary after the post-monsoon inspection. The bridges reconstructed under the project are still new, and unless major damage occurs, no major maintenance costs will be required in the immediate future.

As described above, although maintenance costs are not sufficient, basic maintenance is being carried out with a limited budget, and there are no immediate financial problems for the bridges under this project unless they are severely damaged. Therefore, there are no particular problems with financial sustainability.

Table 3: DoR Maintenance Costs (Unit: million Ngultrum (Nu))

Year	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024
Maintenance Cost for Bridges	8.27	5.064	4.236	4.65	4.097
Total Maintenance Cost	35.572	22.786	19.624	175.525	185.000

Source: Questionnaire results from DoR head office

#### • Environmental and Social Aspect

As analyzed in “Impact,” no environmental nor social issues were identified during or after the completion of the project, and no concerns were found at the time of ex-post evaluation.

#### • Preventative Measures to Risks

At the time of planning, it was assumed that “no large-scale natural disasters would occur” as an external condition. The area on PNH-4 which had to be detoured to transport materials and equipment due to a major landslide during the project period, has been experiencing landslides every year even after the project was completed. According to the executing agency, since the area was geologically infeasible for reinforcement, a detour has been planned. The construction of the detour has been included in the *13th Five-Year Plan*, and a detailed design study have already been conducted at the time of ex-post evaluation. Therefore, preventive measures to risks have been in place.

#### • Current Status of Operation and Maintenance

The maintenance status is considered to be generally good. It was confirmed by inspection that there were no major damages on any of the four bridges, and the drainage outlets on the bridges surface, which are important for maintenance, had been thoroughly cleaned. On the other hand, during the first field survey, several potholes (indentations) were found on the surface of the approach roads of Teleganchu and Beteni bridges. In addition, cracks in the liner plate (earth retaining) of Passang Bridge were observed. The executing agency repaired the damage at these three locations as pointed out by the external evaluator. The completion of repairs was confirmed by photographs of the repaired areas submitted by the executing agency.

Each regional office in charge conducts daily inspections and before and after the monsoon without fail. Bridge surfaces are cleaned and mowed once a week by the NWF. Based on the above, no problems were found in the maintenance status of the bridges.

#### <Evaluation Result>

No issues have been observed in the policy/system, institutional/organizational, technical, financial, and environmental and social aspects, including the current status of operation and maintenance. Risks have been well mitigated. Therefore, sustainability of the project effects is very high.

### III. Recommendations & Lessons Learned

#### • Recommendations to Executing Agency

Minor damages such as potholes in the approach roads and cracks in the liner plates were identified during the field inspection. Although the repairs have been carried out in response to the finding during the field survey of the ex-post evaluation, even minor damages such as this that does not affect the bridge itself should be addressed as soon as it is discovered, before the damage escalates.

#### • Recommendations to JICA

None

#### • Lessons Learned

Establishment of effect indicators in accordance with the difficulty of obtaining and actual situation for the executing agency, and clarification of definition of indicators

“Annual average daily passengers” and “annual average daily cargo” were set as part of effect indicators for this project. Although the executing agency measures annual average daily traffic every year, the number of passengers or the amount of cargo loaded were not measured. In the ex-post evaluation, the estimated figures of passengers and cargos were calculated based on the annual average daily traffic, but could not be simply compared to the actual measured values at the time of planning. It is desirable to set and evaluate effect indicators that can be monitored continuously in accordance with the degree of difficulty and actual situation of obtaining data by the executing agency. If an indicator is to be set that has not been monitored continuously by the executing agency, it is important to clarify the definition of the indicator from the ex-ante evaluation stage (for example, using a breakdown of annual average daily traffic by vehicle type, the capacity of a heavy vehicle is defined as one passenger,



it load capacity as 8 tons, etc.). It is also important to agree on the indicator setting and calculation methods with the executing agency well in advance.

#### IV. Non-Score Criteria

- Additionality

When bridges are constructed with the Japanese grant aid, bridge, approach roads and, if the bridge is located in a mountainous area, measures to prevent slopes on the cut surface on the approach roads, are implemented as a set. On the other hand, in bridge construction usually carried out by the Bhutanese side, due to the budget constraints, measures are taken to keep the slope angle within the specified range depending on the soil type of the slope, but not as extensive as the cutting measures work to be carried out through Japanese grant aid. As a result, even after the construction, rockfalls and landslides can occur during the monsoon season. In comparison, in the vicinity of Teleganchu, Samkhara, Beteni bridges, where cutting measures works were implemented in this project, no such accidents have occurred after the project. The bridge reconstructed project funded by Japanese grant aid is a high value-added project that will not only reconstruct bridges but also implement slope protection works in the surrounding area, thereby further increasing safety and effectiveness of the project.



Slope Protection Works at Beteni Bridge  
(Source: Photo taken by the evaluator)



Repair works of potholes of approach road of  
Teleganchu Bridge (Source: DoR)

(end)