

Bhutan

Ex-Post Evaluation of Japanese Grant Aid Project
“The Project for Reconstruction of Bridges (Phase II)”

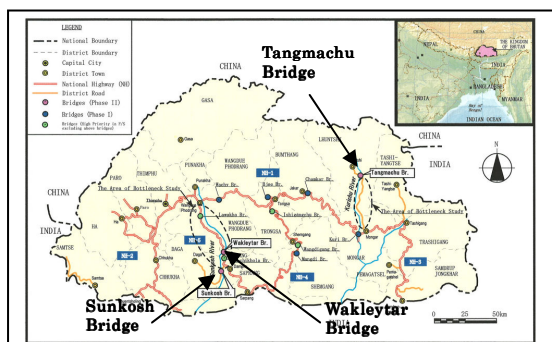
External Evaluator: Keiko Watanabe, FASID

0. Summary

The project was implemented to improve access to the capital or district road by reconstructing three deteriorated bridges (the Wakleytar, Tangmachu and Sunkosh Bridges). The project is highly relevant with government policies as well as the development needs of the country because the bridges play very important roles to secure smooth traffic and given that in Bhutan there are almost no alternative means of domestic transport other than roads. The project also achieves high effectiveness and impact. All the project targets including the increase in allowable loads, the reduction in bridge crossing times, and the increase in the kinds of heavy vehicles, have been met. Besides, the project has contributed to revitalizing the local economy, enhancing safety, and improving living standards. In addition to the points above, the project functioned as a part of a road network in conjunction with improved linking roads and made it possible to transport heavy equipment to conduct large scale infrastructure projects in the surrounding regions. The project period and the cost were within estimated plan, and efficiency of the project is high. Regarding maintenance, there was still room for improvement in regards to the periodical checking practices and therefore sustainability is fair.

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

1. Project Description



(Project Locations)



(Wakleytar Bridge)

1.1 Background

Bhutan is a landlocked country located between Tibet (southwest China) and Assam

(northern India) and has Himalayan Mountains peaks, higher than 7,000m. The road network of Bhutan has been built through these steep mountains and rapid streams. Transportation in Bhutan relies mainly on a road network passing through mountainous terrain and therefore establishing an efficient and safe road network is essential for social and economic development.

The road maintenance and improvement including reconstruction of bridges on the main trunk roads have been implemented by the Department of Roads (DOR), the Ministry of Works and Human Settlement based on the 9th five-year plan of Bhutan. There were many Bailey bridges (temporary steel bridges) on the trunk roads, most of which were constructed before the 1980 and had reached their expected life. These bridges became bottlenecks for providing safe and smooth traffic and for promoting regional development. DOR has been undertaking projects to reconstruct or strengthen these bridges, however, due to their financial and technical constraints, they have been slow to deal with bridges more than 10m long.

Under these circumstances, Japan, in 1997, conducted the study on National Highway Bridge Replacement Project (master plan) for 22 bridges on the trunk roads which were managed by DOR and identified 12 bridges as most urgently in need of replacement. In 2003, 5 bridges out of these 12 priority bridges were replaced with the assistance of Japanese Grant Aid as “the Project for Reconstruction of Bridges”. In August 2003, in order to proceed with the master plan the Government of Bhutan requested the replacement of another 3 bridges out of the 12 priority bridges identified in the Phase II project of “the Reconstruction of Bridges”.

1.2 Project Outline

The objective of this project is to improve access to the capital or district road by reconstructing three deteriorated bridges (the Wakleytar, Tangmachu and Sunkosh Bridges).

Grant Limit/Actual Grant Amount	1,348 million yen / 1,342 million yen
Exchange of Notes Date	Detailed Design: February 15, 2005 Construction: May 27, 2005
Implementing Agency	Department of Roads (DOR), Ministry of Works and Human Settlement
Project Completion Date	October 27, 2007

Project	Main Contractor	Dai Nippon Construction
Implementer	Main Consultant	Construction Project Consultants, Inc.
Basic Design (hereinafter “BD”)		June-December 2004, March 2005 (Supplementary Study)
Related Projects		< Technical Cooperation > 1997: Study on National Highway Bridge Replacement Project 1998-2007: Long-term Experts (Bridges, four in total) 2004-2007: Transportation-Capacity Development for Transport Sector 2009-2012: Senior Volunteers (Bridge Design, two in total) < Grant Aid > 2001: Reconstruction of Bridges 2004: The Project for Improvement of Equipment for Road Construction and Maintenance 2009: Reconstruction of Bridges (Phase III)

2. Outline of the Evaluation Study

2.1 External Evaluator

Keiko Watanabe, Foundation for Advanced Studies on International Development (FASID)

2.2 Duration of Evaluation Study

Duration of the Study: November, 2011 – September, 2012

Duration of the Field Study: March 25, 2012 – April 6, 2012,

May 28, 2012 – June 1, 2012

2.3 Constraints during the Evaluation Study

Impact from this project is expected not only from the construction of the bridges but also from the synergy effect with the linking road as a road network since the project was designed as part of a trunk road network improvement. However, at the time of the ex-post evaluation, the traffic flow was not smooth since the linking roads were still under rehabilitation and some parts were temporarily blocked due to nearby development projects. Therefore, the economic effect, such as the revitalization of the local economy by the improvement of road network, could not clearly be demonstrated. In addition,

changes in the regional disparity before and after the project could not be judged quantitatively because disaggregated quantitative economic indicators by region (such as agriculture production and volume of distribution) were not available. Furthermore, the poverty rate by region has not been updated since 2004.

3. Results of the Evaluation (Overall Rating: A¹)

3.1 Relevance (Rating: ③²)

3.1.1 Relevance with the Development Plan of Bhutan

The project remains in line with the development policy of Bhutan.

Domestic transport in Bhutan relies almost on highway that makes up main road network. Therefore, establishing an efficient and reliable road network is indispensable for social and economic development for the country. However, given the severe natural condition of Bhutan, improving and maintaining Bhutan's road network was a challenge for DOR.

At the time of Basic Design Study, the investment in a road network for economic development was a priority issues in the 8th five-year plan of Bhutan (1997-2002). The overall goals of the sector program in the 9th five-year plan (2002-2007) were also to “upgrade living standard of rural community through improvement of access to social services”, to “establish a road network not depending on roads situated in India”, and to “improve convenience and safety by establishing reliable road network”. Accordingly, much importance was given to the reconstruction of bridges establishing an efficient and reliable road network.

The current 10th five-year plan (2008-2013) prioritizes the expansion of strategic infrastructure and emphasizes that a good and efficient road and transportation network is an absolute requisite for the broader economic and social transformation of Bhutan, a land-locked country with its mountainous and rugged terrain. It also stipulates, “Further development of the road network as an important part of the expansion of strategic infrastructure program will effectively contribute to the reduction of poverty”.

3.1.2 Relevance with the Development Needs of Bhutan

The economy of Bhutan depends much on its exports to India. The ratio of exports to India accounted for 45% of Bhutan's total exports in 2001 and 83% in 2010, of which electricity was the major export product. Thus, since the 1980's, many small and

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

² ③: High, ②: Fair, ①: Low

large-scale hydro-power projects have been initiated with assistance from India, the World Bank and Japan. The road network which sustained these projects had many Bailey bridges constructed at that time. Most of these bridges were deteriorated, damaged badly and passed their service lives, which affected the reliability and safety of road traffic. Additionally, the allowable loads of those Bailey bridges were small (10 to 30 tons), which has become a constraint to efficiently implement development plans such as constructions of hydro-power plants, and road networks including agricultural and feeder roads. They have also affected the establishment of the economical distribution network for lively economic activities. Therefore, this project which aims to remove the bottlenecks for regional development, caused by the existing bridges, met with the development needs of the country.

The three bridges chosen to be reconstructed by this project were selected from the 12 priority bridges identified by the study on National Highway Bridge Replacement project (master plan) completed in 1997 for the following reasons.

- (1) The three bridges have longer spans than the other priority bridges. At the time of the construction, it was technically impossible for the Bhutanese side to reconstruct longer span bridges (more than 30m span);
- (2) All three bridges were Bailey suspension bridges and had been severely damaged; and
- (3) The Wakleytar Bridge and the Sunkosh Bridge on National Road 5 are situated on the transportation route servicing the construction of national hydro-power projects³.

3.1.3 Relevance with Japan's ODA Policy

Japan has assisted the democratization process of Bhutan by focusing on four priority areas, "Agriculture and Rural Development", "Economic Infrastructure Development", "Improvement of Social Services" and "Good Governance". Road and bridge construction is given priority in the area of "Economic Infrastructure Development". Therefore, this project's aim to improve the road network to become the foundation for economic development is aligned with Japan's ODA policy at that time.

In light of the above, this project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy, therefore its relevance is high.

3.2 Effectiveness⁴ (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

³ Projects are such as Punatsangchhu hydro-power project and Dagana hydro-power project.

⁴ Sub-rating for Effectiveness is to be put with consideration of Impact

Three quantitative indicators set in the Basic Design (BD) were achieved as shown in Table 1.

Judging from actual observation as well as interviews with DOR officials and bridge users including local construction companies, bridge crossing times for transportation of heavy cargo has been reduced. The single lane bridges became double lane, allowing vehicles to cross the bridges without waiting for oncoming vehicles. In addition, heavy vehicles loaded with construction equipment no longer needed to dismantle or re-assemble large equipment in order to cross the bridges as was often necessary in the past.

Table 1: Achievement of Quantitative Indicators

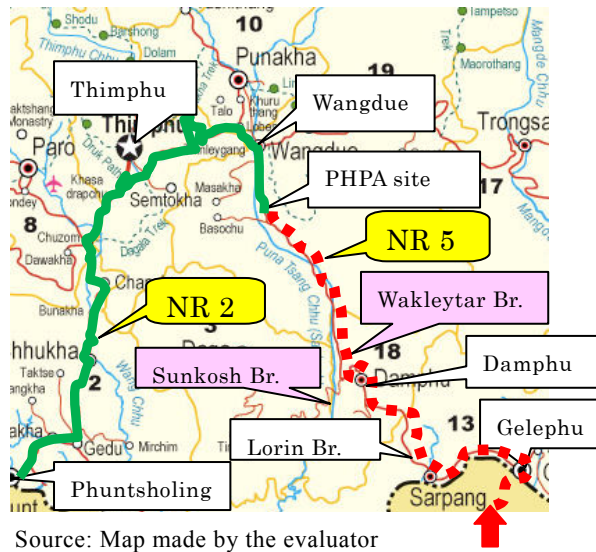
Indicators	Plan		Completion time (2007)	Present (2012)
	Baseline figure (2005)	Expected target (2007)		
Increase in Allowable loads	Wakleytar : 18t Tangmachu : 8t Sunkosh : 12t	40t for all three bridges	As expected	As expected
Reduction in crossing time of the bridges for transportation of heavy cargo	Takes 2 days to dismantle and re-assemble 12t standard size equipment for the Tangmachu Bridge which has only 8t capacity. Takes 30 minutes even for the Wakleytar Bridge which allows trailers loading self-propelled machinery without being dismantled and re-assembled. However, it needs to be unloaded and transported separately from trailer.	Heavy vehicles which loaded construction equipment can cross the bridges less than one min. without waiting for oncoming vehicles. Vehicles loading construction machines do not have to dismantle and unload them when crossing the three bridges.	As expected	As expected
Increase in kinds of heavy vehicle which can pass over the bridges	Only two axle trucks with a loading capacity less than 8t can pass (average traffic volume 26 cars/day at Wakleytar, 9cars/day at Tangmachu, and 13 car/day at Sunkosh)	More than three axle trucks and trailers will be able to pass over the three bridges	As expected	As expected

Source: "Baseline figure" and "Expected target" are from BD (2004), Data for "Completion time" and "Present" are from questionnaire results for DOR and actual observation by ex-post evaluator

However, the ex-post evaluation could not determine whether the total transportation time as a road network has shorten because some parts of the road have been temporarily blocked due to the construction of feeder roads and other development projects. Nevertheless, the effectiveness of the project is expected to be higher in the future when the following construction projects and road network development are completed.

For example, as shown in Chart 1, currently construction equipment and

materials for the Punatsangchhu hydro-power project (PHPA) are transported from India through border town Phuntsoling and Thimphu on National Road 2 (NR 2) and down through Wangdue (NR 5) to PHPA site (green route in Figure 1). It takes about 14-16 hours by heavy vehicles. When the Lorin Bridge is reconstructed by the Phase III project of “Reconstruction of Bridges” by Japanese Grant Aid, the shorter routes crossing the Wakleytar Bridge on NR 5 will be available. It goes from Bongaigaon (India side) through border town Gelephu, Sarpang, Lorin Bridge, Damphu, and the Wakleytar Bridge to PHPA site (red route in Figure 1). The new route will reduce the transportation time by more than half and it will take only 6-7 hours from Gelephu.



Source: Map made by the evaluator

Chart 1: Route to PHPA project site

3.2.2 Qualitative Effects

In order to see the qualitative effects, interviews were conducted with the three DOR Field Division Offices which administer each bridge, residents nearby bridges, hospitals, public bus drivers, construction companies and police officers at the checkpoint for the Wakleytar Bridge⁵. All interviewees pointed out the improvement in safety and reliability compared to before the project. As the condition of the former bridges was very bad, they were unstable and sometimes nails were sticking out from the wooden surface. In this regard, responses from interviews include; “I had to be careful for crossing the bridge

⁵ The interviewees include 5 residents and shop owners nearby each bridge (there were no residents nearby Wakleytar Bridge since it is located on the highway), Checkpoint police officers at Wakleytar Bridge, 3 public bus drivers, 1 doctor, 2 nurses and 2 ambulance drivers at the Hospitals at Damphu and Lhuntse Districts, 4 Construction truck drivers, 2 major construction companies (Lakhi and Nima).

even there was no big baggage but I feel safe when crossing the new bridge”, “Children are able to cross the bridge without getting hurt by the nails after the new bridge was built”, “No traffic accidents have happened since the new bridges were built”, and “patients are able to be transported by ambulance safely”. The improvement in durability, load allowance and two-way traffic reduced accidents caused by heavy vehicles. Therefore, it can be said that the improvement effect of safety has been achieved.

In addition, a great improvement in the living condition of the community by the project was confirmed. Before the project, more than four accidents occurred on the Tangmachu Bridge when heavy vehicles such as excavators and trailer truck carrying excess tons of materials were passing on the bridge in July 2000, August 2000, September 2003 and April 2005. Those accidents damaged its truss and cable which required 1-2 weeks for repair after each accident. During repairs, no vehicle movement over the bridge was possible and people had to walk far to catch buses and carry heavy stuff. The Sunkosh Bridge also had a similar accident in January 2004. Some of hanger ropes were dropped off when an overloaded vehicle was crossing. A shop owner nearby the Sunkosh Bridge appreciated the project since accidents had prevented him from bringing goods for his shop and no such accident which blocked traffic had happened since the project was completed. In addition to that, the Tangmachu Bridge is the only access for the Lhuntse district and the Sunkosh Bridge is the only access for the Dagana district. If these bridges were closed, the community of Lhuntse and Dagana would have been isolated.

As observed above, it was confirmed in the interviews of bridge users that the project surely improved the safety and reliability of the bridges. In addition, the project reduced the risk of isolation in the event that traffic to the Lhuntse and Dagana communities was stopped: effectively contributing to their living conditions.

3.3 Impact (Rating: ③)

3.3.1 Intended Impacts

3.3.1.1 Promotion of local economic activities

In order to assess the expected impact on promotion of local economic activities, the changes in daily traffic volume was assessed using existing data from DOR and conducting interviews with bridge users including residents and shop owners nearby the bridges.

As shown in Table 2, traffic volumes over each bridge have been increasing. Especially that of the Wakleytar Bridge which saw a five-time increase on busy days in 2009

compared to the period before the project. The traffic over the Tangmachu Bridge increased about three time in 2011 compared to after the completion of the project (October 2007). The traffic over the Sunkosh Bridge has doubled.

Table 2: Traffic Volume of three bridges per 12 hours⁶

	Before the Project (2004)	1-2 years After the Construction (2008-09)	3-4 Years after the Construction (2010-11)
Wakleytar Bridge	98-107 vehicles	332-525 vehicles (March 2009)	238-322 vehicles (April 2011)
Tangmachu Bridge	11-28 vehicles	27-109 vehicles (April 2008)	30-46 vehicles (February 2012)
Sunkosh Bridge	60-96 vehicles	105-179 vehicles (September 2008)	109-161 vehicles (March 2012)

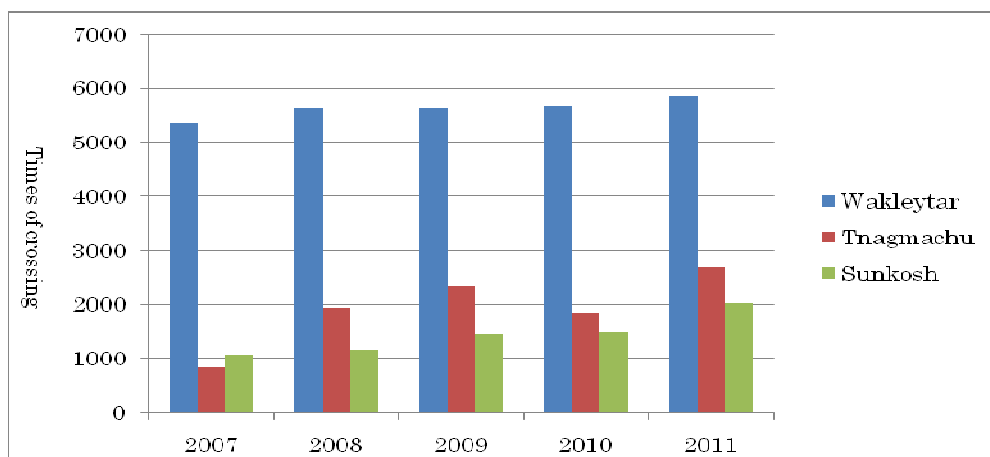
Source: DOR

Chart 2 demonstrates the increase trend in public buses crossing the three bridges⁷. The bus traffic volume over the Wakleytar Bridge was already heavier than that of the other two bridges even before the project since it is situated on the main national highway. Nevertheless it has been increasing slightly year on year responding to the demand. However, it should be noted that the increase in traffic over the three bridges was due largely to the increase in the number of construction vehicles related to infrastructure projects. In the case of the Wakleytar Bridge, the number of vehicles increased in relation to the road rehabilitation and hydro-power projects serviced by National Road 5, and the Phase III project of the “Reconstruction of Bridges” by Japanese Grant Aid which started in 2009. Also for the Sunkosh Bridge, it is assumed that traffic increased due to the Dagana Hydro-power project. For the Tangmachu Bridge, the construction of feeder roads and the Buddha project⁸ affected the increase in the traffic over the bridge.

⁶ The figures are from data available in a traffic count survey done by each Field Division Office. A 12 hours traffic survey (from 6 a.m. to 6 p.m.) for 7 days including Saturday and Sunday is conducted by each Field Division Office basically every six months. The data for the Wakleytar Bridge was from a traffic count done between Wangdue and Wakleytar and collected at the check point nearby the bridge. The data for the Tangmachu Bridge was done between Lhuntse and Thimphu and collected at Gangora. The data for the Sunkosh Bridge was done between Damphu and Sunkosh and collected at the intersection going to Sunkosh from NR 5.

⁷ Annual number of crossing times of public busses over the bridges.

⁸ The construction of a big Buddha is on-going by the private sector in Lhuntse.



Source: Road Safety & Traffic Authority

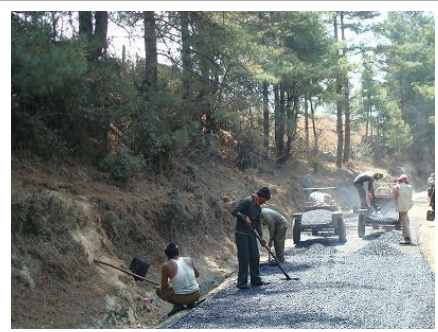
Chart 2: Annual number of crossing times of public busses

According to the farmers and residents, the distribution of agricultural products improved as did the access to the market⁹. They noted that after the project even perishable products which could only be sold at the local markets such as spinach, mangos, oranges and eggs can now be brought to the bigger markets in Punakha, Wangdue and Thimphu.

In this way, positive impact has already been observed. However, it should be noted that the impact on local economic activities cannot be assessed solely based on the construction of the bridges but must include the synergy effect with the connecting road as a total road network. At present the connecting road has been under construction or rehabilitation, therefore, the explicit impact of the project was difficult to be observed. Nonetheless, it can be said that the construction of the bridges created positive economic impact considering that large scale projects such as Dagana hydro-power and road rehabilitation projects could not have been realized without the bridges which have a 40t allowance load. The increase in traffic volume of public buses over bridges and the improvement of access to market for agricultural and livestock products resulted in the active movement of people and goods. Therefore, it can be said that the project has helped to stimulate the regional economy.

⁹ In Bhutan, most farmers depend on subsistence agriculture and the agriculture cooperatives have not been established yet. The Department of Agriculture Cooperatives was only established in 2010 and the agricultural local data including production and distribution has not been established well. Therefore, the quantitative comparison of access to the market before and after the project could not be done.

In addition, according to the Department of Agricultural Marketing & Cooperatives, Ministry of Agriculture & Forests, a new project which aims to deliver agricultural and livestock products for workers at the Punatsangchhu hydro-power project (PAPH) is underway in contract with farmers groups in the Damphu, Punakha, Wangdue and Tsirang districts. The success of the project depends on the access (road and bridges) from these districts to the PPHA site. The Wakleytar and Sunkosh Bridges are located on the way to PPHA from these districts. In this way, the benefit from this project will increase more in the future.



Road construction by NFW



Trucks carrying construction materials

3.3.1.2 Reduction of economic disparity among districts

Since disaggregated economic indicators by districts and regions were not available at the ex-post-project period, the degree of economic disparity among districts could not be backed-up with explicit data. However, it is noted that the project prevented these communities from isolation since the Sunkosh and Tangmachu bridges, which provide the only exit means respectively to the communities of Dagana and Lhuntse, now can avoid closure due to damages by overloaded vehicles. By stabilizing traffic, the project reduced one of the factors that can enlarge economic disparity. On the other hand, it was not clear yet at the time of ex-post evaluation that the project has contributed to reduce economic disparity among regions.

3.3.1.3 Improvement of living standards of people in the district

The project has realized positive effect on the living standard of the communities in terms of people's access to hospitals and income generation. According to interviews with several hospital personnel who use the project bridges for carrying patients to referral hospitals by ambulance, they all appreciated the improvement of the bridges in terms of their safety, smoothness and accessibility.

When referring patients to hospitals in Thimphu (about 20-30 times per month), the Dagana District Hospital uses the Sunkosh and Wakleytar Bridges, whereas the Lhuntse District Hospital relies on the Tangmachu Bridge. The hospital staff stressed some positive impacts in statements such as, “the project made it possible to carry patients and pregnant women safer and more stably at least when crossing the bridges” and “the project shorten travel time since we no longer had to stop before the bridge when oncoming cars were crossing”. In this way, the improvement effect of the bridges has been positively realized.

An additional positive impact was on the income generation of the communities nearby the construction sites, especially the income of shop owners. Since the construction workers for this project used the shops near the project sites to purchase goods and foods, the income of these shops increased. Even after the project many construction workers and people are still using these shops because the project intensified the people’s movement. Especially that was apparent to the shops near the Sunkosh Bridge. The newly constructed bridge enabled to implement large development projects such as the Dagana hydro-power project, so that many people including those involving in development projects have been using the shops. Most of the shop owners interviewed near the Sunkosh Bridge answered that their business improved after reconstruction of the new bridge.

It should be noted, however, that the above mentioned impacts from the improved three project bridges on the regional economy, economic disparity and living standard were realized with the help from the improvement of 15 other small and medium sized bridges along the same road network from the capital, Thimphu. Strengthening or reconstructing these 15 bridges as a precondition of this project was supposed to be borne by the Bhutanese side.

The ex-post evaluation confirmed from DOR and from actual observation that the Bhutanese side has fulfilled its obligation almost as planned as shown in Table 3 below. The current status of these 15 bridges is also shown in the table and most of them will be reconstructed as permanent bridges by the end of 2012.

Table 3: Small and Medium Bridges

Bridges		Around the time of the project	Situation at the ex-post evaluation (2012)
Thimphu — Wangdue — Wakleytar — Sunkosh Route			
1	Hesothankha	Strengthened bridge surface from wood to steel by PHAP project	Concrete bridge is under construction by PHPA
2	Lawakha	Constructed by-pass road	Completed by Japan's Grant Aid Project of "Reconstruction of Bridges (Phase III)" (2011)
3	Basochu	Strengthened bridge surface from wood to steel (2008)	Completed by Japan's Grant Aid Project of "Reconstruction of Bridges (Phase III)" (2011)
4	Rurichu	Strengthened bridge surface from wood to steel (2009)	Concrete bridge is under construction by the financial assistance from Government of India.
5	Baychu	Strengthened bridge surface from wood to steel (2009)	Completed Concrete bridge by the financial assistance from Gov. of India (2011)
6	Kamichu	Strengthened bridge surface from wood to steel (2009)	Completed Concrete bridge by the financial assistance from Gov. of India (2011)
7	Nyarachu	Strengthened bridge surface from wood to steel (2009)	Under construction by Japan's Grant Aid Project of "Reconstruction of Bridges (Phase III)"
8	Mechekola	Constructed by-pass road (2009)	Concrete bridge is under construction by the financial assistance from Government of India.
9	Burichu	Strengthened bridge surface from wood to steel (2009)	Under construction by Japan's Grant Aid Project of "Reconstruction of Bridges (Phase III)"
10	Chachey	Strengthened bridge surface from wood to steel (2009)	Completed by Japan's Grant Aid Project of "Reconstruction of Bridges (Phase III)" (2011)
Thimphu — Lingmethang — Tangmachu Route			
1	No. 4 (Gongola)	Strengthened bridge surface from wood to steel (2008)	Concrete bridge is under construction by DOR
2	Rewanchu	Strengthened bridge surface from wood to steel (2005)	Concrete bridge is under construction by DOR
3	Phawan	Strengthened bridge surface from wood to steel (2008)	Concrete bridge is under construction by DOR
4	Kama Shangshong	Strengthened bridge surface from wood to steel (2006)	Reconstructed in the future by DOR
5	Rongmanchu	Strengthened bridge surface from wood to steel (2006)	Concrete bridge is under construction by DOR

Source: Interview by DOR and actual observation

3.3.2 Other Impacts

3.3.2.1 Impacts on the natural environment

The project acquired environmental clearance from the National Environment Commission in accordance with the National Environment Assessment Act of Bhutan before the implementation. It was confirmed by interviews with the neighboring community and DOR staff that no negative issues on environment such as construction noise, dust, and garbage were identified. In addition, according to the interview with the Department of Forest and Park Services, Ministry of Agriculture and Forestry, no short term environmental impact had been caused by the project's construction garbage and human waste in the potentially affected areas of Bundeling Wildlife Sanctuary and the Thrumshing la National Park, part of which border the construction site of the Tangmachu Bridge.

3.3.2.2 Land Acquisition and Resettlement

There was no resettlement issue for this project.

Regarding land acquisition, it was confirmed by the Japanese project contractor that the project sites for the three bridges had been acquired before the implementation of the project as planned.

As for Tangmachu Bridge, it was necessary to acquire land from a private owner (a fruit farm). DOR obtained mutual agreement from the land owner and issued a letter for land expropriation in June 2004, before the construction started. An interview with the land owner confirmed that the process of the land expropriation was appropriately done and that compensation for the fruits (Mango and Oranges) was paid accordingly by DOR.

Interviews with DOR and the community also found that communities affected by the project had been well informed on the project by DOR staff and by community meetings organized by the Minister of Works and Human Settlement at that time.

3.3.2.3 Unintended Positive/Negative Impact

All three bridges were well acknowledged as “Japanese” bridges by the neighboring community, bridge users and even construction companies in Thimphu. The project enhanced the reputation and credibility of Japan which had been nurtured from Phase I of the “Reconstruction of Bridge” project. This reputation includes the high quality and the design of the bridges, as well as the work ethic and behavior of the Japanese workers during the construction.

The project also contributed to an upgrade in the technical skills and knowledge of DOR staff and helped develop Bhutanese construction workers. The project was coordinated with an on-going JICA technical cooperation project which trained DOR staff on execution supervision and design

of bridges using construction sites of this project as OJT sites. Besides, the project employed only local Bhutanese as construction laborers in view of human resources development of Bhutanese, while most construction projects in Bhutan usually use Indian laborers who are much cheaper than Bhutanese. In this project, a total of 75,000 Bhutanese workers were employed for short- and long-term periods. Some of them started work on the Phase I project and continued to work through to the current Phase III project. Seven workers among them upgraded their skills and became foremen in the Phase III project. According to the Japanese contractor, there was not much opportunity for Bhutanese workers to upgrade their skills like in this project. In addition, those Bhutanese workers who have acquired some technical skills in electricity, welding and machinery from the project became more accessible to other employment opportunity in the construction field.

Another positive impact which was noted in interviews is the enhancement of community's ownership of the bridge. The community near the Sunkosh Bridge organize voluntary cleaning of the bridge every week in addition to the cleaning done by the DOR contracted cleaner. It demonstrates the community's high appreciation and ownership in the bridge.

In light of the above, this project has largely achieved its objectives; therefore its effectiveness is high.

3.4 Efficiency (Rating: ③)

3.4.1 Project Outputs

Planned outputs of the project borne by Japanese side were produced as planned. Details are shown in Table 4. The project used atmospheric corrosion resistance steel (weathering steel) as the bridge material. With this material, it is not necessary to paint and repaint the material, which greatly eased bridge maintenance burden.

Table 4: Design of the Three Bridges

Bridges	Bridge Length (m)	Span Length (m)	Carriageway Width (m)	Bridge Type
Wakleytar	86.0	84.6	6.0	Steel Langer Arch
Tangmachu	70.0	68.6	5.5	Steel Langer Arch
Sunkosh	95.2	93.8	5.5	Steel Langer Arch

Source: Project Completion Report (2008)

Three minor design changes were confirmed as follows. One of them was a modification for the location of the bridge centerline on the Tangmachu Bridge. During the excavation of the base of abutment of the Tangmachu Bridge, the earth at the back slope partially collapsed due to heavy rainfall. Protection measures have been carried out by providing sandbags and cement grout on the slope; however, it was difficult to place an abutment at the originally planned location. Therefore, the centerline of the Tangmachu Bridge shifted by 5m further upstream from the planned location. Second, the height of the retaining wall of the Tangmachu Bridge and the Wakleytar Bridge were changed slightly since the types of soil around each retaining wall were different than initially assumed in the Detailed Design Study. Therefore, the retaining wall of the Tangmachu Bridge was lowered from 5m to 2.5m and that of the Wakleytar Bridge raised by 2.5m. Third, considering the landform and water levels during the rainy seasons, gabion walls were added to both the Tangmachu and the Wakleytar Bridges.

The Bhutanese side requested these changes and they were approved by the Japanese government after the verification of technical justification. They did not undermine the project efficacy, safety and cost.

The Bhutanese side undertook almost all its required work without delay as specified in the Minutes of Discussion of the Basic Design Study including; securing land and providing appropriate compensation, removing the existing three bridges after completion of the project's construction, constructing approach roads at each bridge, strengthening or reconstructing 15 small and medium bridges on the road network affecting accessibility to the project's reconstructed bridges. However, one obligation was not realized. That obligation was to lease the construction equipment which had been procured by Japanese Grant Aid project for "Improvement of Equipment for Road Construction and Maintenance" (2004) for the project. This was justified because the Bhutanese side chose to lease the equipment to private construction companies to conduct national priority projects (road and dam construction). At that time, most of the private construction companies in Bhutan were small and not well-equipped to undertake such large projects. It was confirmed that the project period and cost were not affected by this.

3.4.2 Project Inputs

3.4.2.1 Project Cost

The actual cost of the project was lower than planned; amounting to 1,342 million yen (1,296 million yen for Construction and 46 million yen for Detailed Design). This amount was equivalent to 99.5% of the planned cost of 1,348 million yen. The Bhutanese side

bore some expenses to the project but the actual amount could not be identified. According to the DOR HQs, the cost born by the Bhutanese side was almost as estimated.

3.4.2.2 Project Period

The project period (from the detailed design up to the completion of the project) was shorter than planned. It was 30.7 months (920 days) equivalent to 94.4% of the estimated period of 32.5 months (975 days)

Table 5: Planned and Actual Project Period

Planned	Actual
32.5 months/975 days (including detailed design and bidding periods)	April 20, 2005 (Detailed Design Study) ~October 27, 2007 (Completion Day) (30.7 months/920 days)

Source: Project Completion Report (2008)

Both project cost and project period were as planned, therefore efficiency of the project is high.

3.5 Sustainability (Rating: ②)

3.5.1 Structural Aspects of Operation and Maintenance

DOR is in charge of operation and maintenance of the bridges. Daily maintenance including cleaning of roads and bridges is basically organized by the local DOR Field Division Offices, but since 2011 maintenance of some parts of the roads and bridges has been outsourced to private companies as a trial. As for the three project bridges, the Lobesa Field Division Office is in charge of the Wakleytar Bridge and the Sarpang Field Division Office is in charge of the Sunkosh Bridge. The Lingmethang Field Division Office used to be in charge of the Tangmachu Bridge, however since May 2011 the route between Lhuntse and Galagpa, including the Tangmachu Bridge has been outsourced and maintained by the Construction Development Corporation Limited (CDCL), which used to be a mechanical division of DOR. Daily maintenance including sweeping, cleaning drainage and jungle clearing are actually done by the National Work Force (NWF) under contract with DOR Field Division offices or by external contractors. NWF is a Bhutanese labor organization registered at DOR.

Table 6 shows the number of staff of DOR HQs and the relevant DOR Field Division Offices.

Table 6: Number of Staff at DOR HQ and Relevant Field Division Offices

DOR Offices	Executive Engineer	Engineer /Junior Engineer	Other staff	Total no. of staff
DOR Headquarters	4	4	2	10
Lobesa Field Division (Wakleytar)	6	11	25	42
Lingmethang Field Division (Tangmachu)	3	12	20	35
Sarpang Field Division (Sunkosh)	6	8	32	46

Source: Each DOR office

35-46 staff members have been allocated to each Field Division Office. 30-40% of the staff in each office has a certain degree of technical skills to conduct daily technical maintenance. In terms of manpower no problem has been raised so far given that the bridges were constructed with atmospheric corrosion resistance steel which minimizes the burden of maintenance and also because daily cleaning is done by the NWF. Therefore, to date, no structural issues have been observed.

3.5.2 Technical Aspects of Operation and Maintenance

As stated above, the steel used for the bridges minimizes the maintenance burden and no technical problem in maintenance has been reported so far. In case there is a technical problem or major rehabilitation issue which cannot be taken care of at the field level, the Field Division office will request the DOR HQs for assistance. Engineers at the HQs have received training from Japanese experts and JICA volunteers on planning, design, and construction of bridges starting from Phase I and continuing on through Phase III projects, as well as during past technical cooperation projects. It is assumed, therefore, the engineers at HQs can cope with almost any technical maintenance issues.

However, the ex-post evaluation study found that periodical maintenance has not been practiced. A systematic maintenance system should be established. Neither the HQs nor the Field Division Offices have used the bridge maintenance manual provided by the Japanese project consultant. Also, although there is a reference of bridge maintenance in DOR (formulated in 2005 by DOR), it has also not been used. According to DOR, they are currently formulating a “standard guideline for operation and maintenance of bridges” based on the above 2005 reference and will finalize it in the middle of 2012. In order to be more effective maintenance, the new guideline should include a checklist of periodical maintenance and should be printed as early as possible.

DOR HQs also need to instruct the guideline to the Field Division Offices, monitor their practice, and provide feedback.

Regarding future bridge construction and rehabilitation plans, DOR has formulated a plan and incorporated it into the 11th five-year plan. Based on the assessment of the current situation, (assisted by a JICA senior volunteer on bridge design dispatched from 2009) DOR has identified priority bridges for construction and rehabilitation for the next five years.

3.5.3 Financial Aspects of Operation and Maintenance

The budget for the maintenance is Nu. 26,000 (about 40,000 yen) per completed bridge per year. The amount of the budget is requested to the Ministry of Finance through DOR HQs and has been approved every year without any reduction. The amount covers personnel costs for NFW, daily checking, cleaning materials, replacing bridge surface, and simple repair. Some bridges do not need the full amount of the budget and any reserves can be allocated to other bridges. So far no critical shortage for the maintenance has been reported. In case of necessary major repair such as those caused by accidents, DOR HQs, upon application from the Field Division Office, will request the Ministry of Finance to disburse a supplementary budget. Since roads and bridges are one of the highest priority issues in Bhutan and the project bridges are situated on major roads, an immediate response can be assumed. In addition, in consideration of an increase in NWF wages, the maintenance budget was increased (Nu. 30,000 per bridge per year) for the 11th five-year plan starting from 2013.

As observed above, considering roads and bridges as high priority issues in Bhutan's policy, operation and maintenance cost has been allocated as budgeted and it is expected to continue to secure the financial sources for them. Accordingly, any financial issue has not been identified.

3.5.4 Current Status of Operation and Maintenance

All three bridges have been maintained in good condition without any sand sediment on the surface which was pointed out in the inspection report. It was observed that the NWF has been cleaning the bridge surface and drainage almost every day for the Wakleytar Bridge and the Sunkosh Bridge, and every week for the Tangmachu Bridge. As mentioned before, the community near the Sunkosh Bridge has organized themselves to undertake

weekly cleaning such as removing weeds and garbage.

Simple checking is being done by each Field Division Office every week for the Wakleytar Bridge and the Tangmachu Bridge. Since the Sunkosh Bridge is far from the Lingmethang Field Office, it was found that checking is done when necessary. The HQs have undertaken monitoring once or twice every year.



Cleaning bridges by NWF

On the other hand, it was found that although periodical checking was recommended in the Basic Design as well as in the DOR's maintenance reference of 2005, such checks have not been made. It was found that the monitoring of periodical checking from the HQs has not been done. Although with simple daily maintenance like cleaning and checking no serious problems have been reported, it is still useful to establish a periodical checking mechanism. The mechanism should include specifying who, what, when and how the check will be done. It also will be useful to estimate the time and scale of any major repairs.

For instance, the ex-post evaluation study found that the left side of gabion wall of the Wakleytar Bridge (lowered by the flood in 2009) has not been repaired yet. Since it was considered not urgently affecting the effectiveness and safety of the bridge, the wall remained un-repaired and the time of repair was not specifically planned. If a maintenance mechanism was established including a practice of periodical checking, such matter could have been responded promptly. Following the ex-post evaluation, DOR will undertake



Lowering gabion wall of Wakleytar Br.



Uninstalled name plate at Tangmachu Br.

repair of the gabion wall of the Wakleytar Bridge in the next fiscal year since there are no constraints in terms of budget, technical skills and manpower. In addition, the name plates of the Tangmachu Bridge will be installed by DOR next fiscal year which was also pointed out by the ex-post evaluation.

Some problems have been observed in terms of periodical maintenance practices, therefore the sustainability of the project effect is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project was implemented to improve access to the capital or district road by reconstructing three deteriorated bridges (the Wakleytar, Tangmachu and Sunkosh Bridges). The project is highly relevant with government policies as well as the development needs of the country since the bridges played very important roles to secure smooth traffic given that in Bhutan there are almost no alternative means of domestic transport other than roads. The project also achieves high effectiveness and impact. All the project targets including the increase in allowable loads, the reduction in bridge crossing times, and the increase in the kinds of heavy vehicles, have been met. Besides, the project has contributed to revitalizing the local economy, enhancing safety, and improving living standards. In addition to the points above, the project functioned as a part of road network in conjunction with improved linking roads and made it possible to transport heavy equipment to conduct large scale infrastructure projects in the surrounding regions. The project period and the cost were within the estimated plan, and the efficiency of the project is high. Regarding maintenance, there was still room for improvement in regards to the periodical checking practices and therefore sustainability is fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

- It is necessary to establish a periodical checking mechanism that includes stipulating who, what, when and how the check will be done. The mechanism will be useful to estimate the time and scale of major repairs. The mechanism should include: identification of items to be checked, the actual practice of checking, making plans for repair based on the checking result, the actual repair, and

follow-up monitoring by HQs. This kind of periodical checking procedure should be included in the new standard guideline for maintenance being formulated by DOR in referring the maintenance manual which the project has formulated.

- DOR HQs should undertake an initiative to instruct the Field Division Offices to undertake periodical checking based on the new guideline, conduct monitoring of the practice, and provide feedback to Field Division Offices based on the results.

4.2.2 Recommendations to JICA

There is no particular recommendation to JICA.

4.3 Lessons Learned

- One aspect which has enhanced the project's sustainability is that the design of the project took the operation and maintenance capacity of the executing agency into consideration. In this project, the design of the bridge minimized the burden of cost and workload on the executing agency, which enabled the operation and maintenance without establishing additional structures and cost. When designing the project the capacity as well as the conditions surrounding the executing agency should be well looked into.
- When a bridge construction project is formulated, it should keep the following in mind so that the expected impact will be enhanced: seeing bridges as part of road networks and taking account of contribution to the entire road network. In this project, the Wakleytar and Sunkosh Bridges are located on the NR 5 that has been strategically important as a transport route from India and has handled traffic with construction materials for large scale national projects. In addition, the Sunkosh and Tangmachu Bridges are essential for people in Damphu and Lhuntse districts to access other regions: the project actually resulted in enhancing road accessibility from/to these districts. The project's synergy effect was also enhanced as the project decided to include improvements on small and medium bridges on the road network as a part of project design. The on-going Phase III project of reconstruction of bridges is also taking the view of bridges as a part of the road network and therefore decided to target the 6 bridges on the important NR 5 road, and this will further enhance the effectiveness of this project.