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| Country Name | Technical Cooperation for Landslide Mitigation Project |
| Democratic Socialist Republic of Sri Lanka | |

I. Project Outline

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|--|--|--------------|---|---------------|----------------|--|--|---|---|--|---|--|--|
| Background | <p>Sediment disaster (landslide) was one of the major natural disasters in Sri Lanka. The National Building Research Organization (NBRO) is responsible for implementing landslide disaster countermeasures and issuing early warnings. The NBRO had been mainly engaged in non-structural measures, such as the development of relatively inexpensive hazard maps but began to take on structural measures in response to social demands. On the other hand, the achievements of the NBRO were still insufficient, and it was necessary to improve the ability of NBRO staff to conduct surveys, design, and supervise the construction of countermeasures for landslides.</p> <p>In March 2014, the Japanese ODA Loan Agreement for the Landslide Disaster Protection Project of the National Road Network (hereinafter referred to as “the ODA loan project”) was signed. This ODA loan project, covering seven districts, including the target districts of this technical cooperation project, was to carry out countermeasure construction on slopes on major national roads with a high risk of landslides. Under such circumstances, the Government of Sri Lanka requested the Government of Japan to implement this technical cooperation project as a complementary project to the mentioned ODA loan project.</p> | | | | | | | | | | | | |
| Objectives of the Project | <p>Through the application of appropriate sediment disaster (landslide) mitigation measures with Japanese and other technology in the pilot project sites, the project aims at improving the sediment disaster (landslide) management capacity of NBRO, thereby having sediment disaster (landslide) measures implemented directly by NBRO or with the assistance of NBRO with acquired technology and experience from the project.</p> <ol style="list-style-type: none"> Overall Goal: Sediment disaster (landslide) countermeasures are implemented directly by NBRO or with the assistance of NBRO with acquired technology and experience from the Project. Project Purpose: Sediment disaster (landslide) management capacity of NBRO is improved through application of appropriate mitigation measure with Japanese and other technology in the pilot project sites. | | | | | | | | | | | | |
| Activities of the Project | <ol style="list-style-type: none"> Project Site: Kandy, Matale, Nuwara Eliya and Badulla Districts¹ Main Activities: (For sediment disaster (landslide) and rock fall mitigation measures) investigations, monitoring and evaluation of disaster, and design, tender, construction supervision of mitigation measures in the pilot area; (For slope failure mitigation measures) monitoring and evaluation of slope failure and design of mitigation measures in the pilot area; (For gaining knowledge and know-how) review and updating of existing guideline and technical manual on structural measures, training/technical seminars/workshops, stakeholder consultation on land use regulation for mitigation and early warning, preparing materials on land use regulation for mitigation. Inputs (to carry out above activities) <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Japanese Side</td> <td style="width: 50%;">Sri Lanka Side</td> </tr> <tr> <td>1) Experts: 15 persons (1 long-term and 14 short-term)</td> <td>1) Staff allocated: Counterpart personnel (C/P) from NBRO Headquarters and NBRO District Offices of Badulla, Nuwara Eliya, Matale, and Kandy</td> </tr> <tr> <td>2) Trainees received: 10 persons in Japan</td> <td>2) Land, building, and facilities: Office space for the Consultant Team</td> </tr> <tr> <td>3) Equipment: Office equipment, equipment for monitoring (extensometer, inclinometer, groundwater level gauge, and pipe strain gauge with piezometer), a drilling machine, and an air compressor</td> <td>3) Local cost: Costs for transportation and taxes</td> </tr> <tr> <td>4) Local cost: Fees for construction of countermeasures, travel expenses, stationaries, communication, workshop venues, etc.</td> <td></td> </tr> </table> | | | Japanese Side | Sri Lanka Side | 1) Experts: 15 persons (1 long-term and 14 short-term) | 1) Staff allocated: Counterpart personnel (C/P) from NBRO Headquarters and NBRO District Offices of Badulla, Nuwara Eliya, Matale, and Kandy | 2) Trainees received: 10 persons in Japan | 2) Land, building, and facilities: Office space for the Consultant Team | 3) Equipment: Office equipment, equipment for monitoring (extensometer, inclinometer, groundwater level gauge, and pipe strain gauge with piezometer), a drilling machine, and an air compressor | 3) Local cost: Costs for transportation and taxes | 4) Local cost: Fees for construction of countermeasures, travel expenses, stationaries, communication, workshop venues, etc. | |
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| Project Period | (ex-ante) July 2014–June 2017 (actual) July 2014–September 2018 | Project Cost | (ex-ante) 509 million yen, (actual) 363 million yen | | | | | | | | | | |
| Implementing Agency | National Building Research Organization (NBRO) | | | | | | | | | | | | |
| Cooperation Agency in Japan | Earth System Science Co., Ltd. Nippon Koei Co., Ltd. | | | | | | | | | | | | |

II. Result of the Evaluation

<Special Perspectives Considered in the Ex-Post Evaluation>

- Available project reports do not explicitly show the target number required for the Project Purpose Indicator, “Number of completed sediment disaster mitigation works designed, supervised and monitored by NBRO in the pilot areas in enhanced manners.” For this evaluation, the target number can be considered as three (3) since the implementation of a set of sediment disaster (landslide) and rock fall mitigation works were planned at three pilot sites. (The implementation of the pilot slope failure mitigation works for the Kandy Nurse Training School site was originally planned but later excluded from the project plan as the project decided to cover the process up to design.)

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| 1 Relevance/Coherence |
| [Relevance] |
| <Consistency with the Development Policy of Sri Lanka at the Time of Ex-Ante Evaluation > |

¹ The pilot area included the sites of (i) Kandy Nurse’s Training College Slope Failure, (ii) Matale Alagumale Rockfall, (iii) Nuwara Eliya Udamadura Landslide, and (iv) Badulla Badulusirigama Landslide.

The project was consistent with the development policy of Sri Lanka at the time of ex-ante evaluation. The project is aligned well with the Sri Lanka Disaster Management Plan (NDMP) 2013–2017 and the Sri Lanka Comprehensive Disaster Management Programme 2014–2018. In the NDMP, Activity 3-2 is “Landslide Hazard Zonation Mapping by NBRO.” The Management Programme sets “Disaster Mitigation and Mainstreaming Disaster Risk Reduction (DRR) into Development” as one of the priority strategies, and one of the major outputs under the strategy is “slopes stabilized in identified high-risk landslides and rock falls sites.”

<Consistency with the Development Needs of (country name) at the Time of Ex-Ante Evaluation >

As mentioned in the “Background” above, the project was consistent with the development needs of Sri Lanka (improving the ability of NBRO staff to conduct surveys, design, and supervise the construction of countermeasures for sediment disasters (landslides)) at the time of ex-ante evaluation.

<Appropriateness of Project Design/Approach>

The project design/approach was appropriate. No problem attributed to the project design/approach was confirmed.

<Evaluation Result>

In light of the above, the relevance of the project is ③ (④ : very high, ③ : high, ② : moderately low, ① : low * To be the same afterwards.).

[Coherence]

<Consistency with Japan’s ODA Policy at the Time of Ex-Ante Evaluation>

The project was consistent with the Japan’s ODA policy to Sri Lanka at the time of ex-post evaluation. One of the priority areas of the Country Assistance Policy for Sri Lanka (June 2012) is “mitigation of vulnerabilities,” and the Policy highlights the need to assist disaster management.

<Collaboration/Coordination with other JICA’s interventions>

Any collaboration/coordination between the project and other JICA’s intervention was not clearly planned at the time of ex-ante evaluation.

<Cooperation with other institutions/ Coordination with international framework>

Any cooperation/coordination with other development partners was not clearly planned at the time of ex-ante evaluation.

<Evaluation Result>

In light of the above, the coherence of the project is ②.

[Evaluation Result of Relevance/Coherence]

In the light above, the relevance/coherence of the project is ③.

2 Effectiveness/Impact

<Status of Achievement of the Project Purpose at the Time of Project Completion>

At the time of project completion, the Project Purpose was achieved as planned. The project completed the investigation of all four pilot sites and completed the planning and evaluation, design, construction, supervision, and monitoring of landslide and rockfall measures at the three pilot sites as planned. As confirmed in the terminal evaluation, NBRO enhanced its capacity in terms of investigation, analysis, monitoring, and construction supervision by joint undertakings of these activities through the application of appropriate mitigation measures with Japanese and other technology in the pilot project sites. With the experience and lessons learned from its activities, the project prepared the “Manual for Design and Supervision of Countermeasure Works against Landslide (Sediment Disaster).”

<Continuation Status of Project Effects at the Time of Ex-Post Evaluation>

By the time of the ex-post evaluation, the project effects have been partially continued. The facilities constructed under the project are maintained by NBRO and related organizations such as the divisional secretariat and community (Matale Alagumale Rockfall site and Nuwara Eliya Udamadura Landslide site) and Uva Wellasa University (Badulla Badulusirigama Landslide site), while there are minor repairs to be done. The monitoring equipment provided under this project was utilized until 2020, when operation and maintenance became difficult as sufficient budget was not allocated and the lockdown was imposed due to the COVID-19 pandemic. As of January 2023, however, NBRO resumed the maintenance (repair) of the equipment using its common organizational budget for 2023. The manual developed under this project is utilized for NBRO’s operation at the time of the ex-post evaluation, but it has not been published as an official document due to its limited coverage. At the time of the ex-post evaluation, NBRO is working on upgrading the manual to an overall landslide management/mitigation guideline for the entire country and collecting additional information through the ongoing AIIB project.

<Status of Achievement of the Overall Goal at the Time of Ex-Post Evaluation>

At the time of ex-post evaluation, the Overall Goal has been mostly achieved as planned. NBRO still utilizes the technologies transferred through this project. These technologies were known and partially used before this project but were taken from concept to practical level and further improved by this project. Especially, the staff capacity on these technologies were improved. After 2019, 200 or more high-risk landslide and rockfall sites throughout the country were recorded, and most of them were identified for mitigations. The government funds and the external funding from AIIB and the World Bank² were mainly used for these mitigation works using different types of countermeasures. The types of mitigation measures have become more diversified and improved. During this JICA project, NBRO mainly used mitigation works involving subsurface and surface drain system developments and rock fall protection walls. Up to the time of the ex-post evaluation, other projects introduced techniques that this project did not handle, such as soil nailing, drainage wells, different type of retaining structures, grid beams, etc. though NBRO commented that when applying those techniques, they could easily follow up the systematic approaches of work control and regular monitoring learned from this JICA project. On the other hand, it is questionable whether the contribution of this project to these improvements well reached the expected level. The project focused on technology transfer related to structural countermeasures through the pilot projects, and the techniques/experience gained through the pilot projects includes (i) approaches in survey, planning, and monitoring and (ii) individual countermeasure works. In the former aspect, it can be said that the project’s technology and experience are being used mainly as an extension of the technology and knowledge originally possessed by

² Government funded projects: Continuing mitigations in small locations. Climate Resilience Improvement Project (CRIP; supported by the World Bank): 18 Schools and 23 sites along roadside have been completed. AIIB project: 147 sites: 20 landslide sites have been completed, 6 sites are in progress, and 32 sites already selected civil contractors.

NBRO, while, in the latter aspect, the project's contribution to the countermeasure works at the time of the post-evaluation is considered to be partial.

<Other Impacts at the Time of Ex-Post Evaluation>

No negative impacts on the natural environment have been observed. There was no land acquisition for this project. When implementing the pilot mitigation works, NBRO held an awareness meeting at each project site for residents. To ensure smooth construction work, NBRO asked residents to understand and cooperate with the project. In addition, it can be said that the project had a positive impact regarding social inclusion: if the mitigation works were not implemented, the community could have been divided into groups due to evacuation. As another positive impact, the improved capacity of NBRO through this project contributed to the implementation of the ODA loan project as the techniques from this project were used together with NBRO's techniques and know-how.

<Evaluation Result>

In light of the above, the effectiveness/impact of the project is ③.

Achievement of Project Purpose and Overall Goal

| Aim | Indicators | Results | Source | | | | | | | | | | | | | | | | |
|---|---|--|--------------------------------------|---|--|---|--|---|---|---|--|---|--|---------------------|----------------------------------|-------------------------|---|---------------------|--|
| (Project Purpose) Sediment disaster (landslide) management capacity of NBRO is improved through application of appropriate mitigation measure with Japanese and other technology in the pilot project sites. | Number of completed sediment disaster mitigation works designed, supervised and monitored by NBRO in the pilot areas in enhanced manners. | <p>Status of the Achievement (Status of the Continuation): achieved as planned (partially continued) (Project Completion) Three mitigation works were completed: Matale Alagumale Rockfall, Nuwara Eliya Udamadura Landslide, and Badulla Badulusirigama Landslide. (Ex-Post Evaluation)</p> <table border="1"> <thead> <tr> <th>Site</th> <th>Maintenance of the site was handed over to:</th> <th>Conditions of the site at the time of ex-post evaluation</th> <th>Monitoring visits by NBRO</th> </tr> </thead> <tbody> <tr> <td>Matale Alagumale Rockfall</td> <td>Divisional secretariat and community</td> <td>Good. Although there is no regular monitoring, the community generally informs NBRO of major rock falls.</td> <td>Yes, when possible.</td> </tr> <tr> <td>Nuwara Eliya Udamadura Landslide</td> <td>Community, but it seemed that they were not clear about the handover process.</td> <td>Site clearing and maintenance are not up to the standard, and damages were not rectified as there is no separate budget for operation and maintenance.</td> <td>Yes, when possible.</td> </tr> <tr> <td>Badulla Badulusirigama Landslide</td> <td>Uva Wellassa University</td> <td>The University clears the site but not regularly. Some minor damages were observed in the constructions but have not been rectified yet. NBRO collected data after the project up to 2020. But currently, NBRO does not collect any data from the site.</td> <td>Yes, when possible.</td> </tr> </tbody> </table> | Site | Maintenance of the site was handed over to: | Conditions of the site at the time of ex-post evaluation | Monitoring visits by NBRO | Matale Alagumale Rockfall | Divisional secretariat and community | Good. Although there is no regular monitoring, the community generally informs NBRO of major rock falls. | Yes, when possible. | Nuwara Eliya Udamadura Landslide | Community, but it seemed that they were not clear about the handover process. | Site clearing and maintenance are not up to the standard, and damages were not rectified as there is no separate budget for operation and maintenance. | Yes, when possible. | Badulla Badulusirigama Landslide | Uva Wellassa University | The University clears the site but not regularly. Some minor damages were observed in the constructions but have not been rectified yet. NBRO collected data after the project up to 2020. But currently, NBRO does not collect any data from the site. | Yes, when possible. | Source: Terminal Evaluation Report; NBRO |
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| (Overall Goal) Sediment disaster (landslide) countermeasures are implemented directly by NBRO or with the assistance of NBRO with acquired technology and experience from the Project. | <p>All sediment disaster (landslide) countermeasures are implemented (including the commencement of a preliminary survey) or assisted by NBRO with acquired technology and experience from the Project.*</p> <p>* All sediment disaster (landslide) countermeasures exclude countermeasures that do not require "acquired technology and experience from the Project." "Acquired technology and experience from the Project" are defined as either of the following technologies and its experiences: 1) Use of drone technology for landslide mitigation survey, 2) Design of countermeasures using back analysis, 3) Long horizontal drilling with a casing (longer than 20 meters) and/or 4) Systematic construction supervision with a measurement sheet.</p> | <p>(Ex-Post Evaluation) mostly achieved as planned The techniques/experience specified for this indicator is related to approaches in survey, planning, and monitoring, and they are used mainly as an extension of the technology and knowledge originally possessed by NBRO.</p> <table border="1"> <thead> <tr> <th>Technology subject to this indicator</th> <th>Status of the utilization of the technology</th> </tr> </thead> <tbody> <tr> <td>1) Use of drone technology for landslide mitigation survey</td> <td rowspan="2">These are used for all countermeasures. Before the project, the technology remained conceptual. As a result of the project, the technology became common and popular in NBRO as the concept was practically realized.</td> </tr> <tr> <td>2) Design of countermeasures using back analysis</td> </tr> <tr> <td>3) Long horizontal drilling with a casing (longer than 20 meters)</td> <td>NBRO already utilized this technology even before the project, but they only had insufficient experience and very limited staff who were trained. As a result of the project, the technology was improved, and many staff members improved their capacity. Currently, NBRO improved to drill more than 70m. In addition, the capacity to provide practical solutions for problems faced during the drilling was improved.</td> </tr> <tr> <td>4) Systematic construction supervision with a measurement sheet</td> <td>NBRO still uses the measurement sheet. Supervision is a compulsory process for NBRO's landslide mitigation works. Government-funded projects are directly supervised by the Project Management Division of NBRO; for mega-scale projects such as AIB programs, a separate Supervision Consultancy is used jointly.</td> </tr> </tbody> </table> | Technology subject to this indicator | Status of the utilization of the technology | 1) Use of drone technology for landslide mitigation survey | These are used for all countermeasures. Before the project, the technology remained conceptual. As a result of the project, the technology became common and popular in NBRO as the concept was practically realized. | 2) Design of countermeasures using back analysis | 3) Long horizontal drilling with a casing (longer than 20 meters) | NBRO already utilized this technology even before the project, but they only had insufficient experience and very limited staff who were trained. As a result of the project, the technology was improved, and many staff members improved their capacity. Currently, NBRO improved to drill more than 70m. In addition, the capacity to provide practical solutions for problems faced during the drilling was improved. | 4) Systematic construction supervision with a measurement sheet | NBRO still uses the measurement sheet. Supervision is a compulsory process for NBRO's landslide mitigation works. Government-funded projects are directly supervised by the Project Management Division of NBRO; for mega-scale projects such as AIB programs, a separate Supervision Consultancy is used jointly. | Source: NBRO | | | | | | | |
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3 Efficiency

The project cost was within the plan (the ratio against the plan: 71%), and the project period exceeded the plan (the ratio against the plan: 142%). The project period exceeded the plan because, during the construction stage of the pilot mitigation works, there were some additional requirements that had to be addressed with the community requirements. Also, some works took additional time due to the

contractor's capacity. The Outputs were produced as planned.

In the light above, the efficiency of the project is ③.

4 Sustainability

<Policy Aspect>

The existing policies, such as NDMP and Sri Lanka Comprehensive Disaster Management Programme, are still in practice and support the outcome of the project. Although there is a minor issue that specific policies for landslides have not been developed yet in Sri Lanka, the development of landslide mitigation-related policies (guidelines) has been initiated and is in process, to which this project has contributed.

<Institutional/Organizational Aspect>

There have not been major changes in the organizational structure for landslide management of NBRO, but further improvements have been made, such as the stabilization of Designing team, Project Supervision and construction management team, and Project Management units. Works are shared among the existing staff (nearly 400–450 staff members, including temporary staff). Although there is a minor issue that some staff members involved in this project at the district office level were transferred after the project, it has not undermined the works. When there are additional requirements to fulfill, it is a practice for NBRO to hire experts.

<Technical Aspect>

The majority of the trained staff by the project are still at NBRO, and necessary knowledge-sharing systems are also in place. NBRO uses the manual developed by this project as a guidebook, a base document for NBRO's operation at the time of the ex-post evaluation. As already mentioned, this document will be updated and legalized in the future. The equipment provided under the pilot mitigation works of this project has generally been maintained except for the suspension period due to the COVID-19 pandemic, as mentioned above.

<Financial Aspect>

The amount of the budget for NBRO's landslide management varies every year depending on the government's budget and allocation. NBRO allocates a separate budget for the maintenance of landslide mitigation facilities based on priority considering various factors such as risk level, emergency, safety of people, etc. The pilot site facilities constructed by this project have not been allocated a separate maintenance budget as these facilities have not yet been identified as those subject to rectification. Besides, NBRO uses its common organizational budget to disseminate and promote the outcomes of this project. Some of the completed mitigated landslide locations are handed over to relevant authorities such as the Road Development Authority, local authorities, and schools. On such occasions, NBRO conducts necessary trainings for the relevant officials of such organizations by using NBRO's budget, although NBRO does not have a separate budget for promotional (awareness-raising) events.

<Environmental and Social Aspect>

No issues with the environmental and social aspects caused by this project have been observed, and it has not been necessary to take any countermeasures.

<Evaluation Result>

In light of the above, some problems have been observed in terms of the policy, institutional/organizational, technical, and financial aspects of the implementing agency, while those in the policy, institutional/organizational, and technical aspects are minor. Therefore, the sustainability of the project effects is ②.

5 Summary of the Evaluation

The project achieved the Project Purpose of improving NBRO's landslide management capacity and mostly achieved the Overall Goal of having landslide measures implemented with acquired technology and experience from the project. After the project completion, the project effects have partially continued as the facilities constructed under the pilot mitigation works have been effective but have maintenance issues. In the financial aspect of sustainability, whether to implement mitigation measures and give maintenance to completed mitigation works depends on budget availability. However, sustainability in terms of policy, institutional/organizational, and technical aspects is generally ensured with only some minor issues. As for efficiency, the project period exceeded the plan.

Considering all of the above points, this project is evaluated to be satisfactory.

III. Non-score Items

Adaption and Contribution:

- JICA (head office and country office) fulfilled its duties, such as administrative support and dispatch of the relevant consultant on time. It conducted appropriate supervision, such as progress reviews and site visits on a regular basis. Also, necessary counterpart trainings were arranged and supported by JICA. Effective communication between JICA and the counterpart organization and collaboration among stakeholders were made to implement the project.
- The consultant closely worked with the staff of the counterpart organization and shared the necessary technical knowledge with them.

Additionality and Creative Values:

- "The Manual for Design and Supervision of Countermeasure Works Against Landslide (Sediment Disaster)" was initiated as a novel idea from Japan. At the time of the ex-post evaluation, NBRO utilizes the manual practically as the guidelines for their current operations and has initiated the legalization of this document in Sri Lanka.

IV. Recommendations & Lessons Learned

Recommendations for Implementing Agency:

- NBRO is recommended to conduct systematic post-monitoring of the landslide mitigation facilities constructed by this project. At the same time, NBRO is recommended to allocate the necessary budget for the operation and maintenance of these facilities to ensure sustainability.

Lessons Learned for JICA:

- System and necessary approaches need to be included in the project proposal to ensure the counterpart budget for post-monitoring and operation & maintenance of the facility construction.



(Drainage in Badulusirigama, Badulla)
No damages and function well.



(Horizontal Drain)
Functioning well



(Extensometer, Udamadura, Nuwara Eliya)
Damaged and need to be repaired.



(Drainage, Udamadura, Nuwara Eliya)
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