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|--|---|
| Country Name                               | <b>Capacity Development Project for Creating Digital Elevation Model Enabling Disaster Resilience</b> |
| Democratic Socialist Republic of Sri Lanka |   |

**I. Project Outline**

|  |  |              |  |               |                 |                                       |   |                                   |  |  |  |
|--|--|--------------|--|---------------|-----------------|---------------------------------------|---|-----------------------------------|--|--|--|
| Background                                       | <p>The Democratic Socialist Republic of Sri Lanka (hereinafter referred to as “Sri Lanka”) was affected by the climate changes, and many natural hazards such as flood and landslides had resulted in the loss of human lives and the damage of infrastructure. Under these circumstances, the Government of Sri Lanka (hereinafter referred to as “GOSL”) announced a policy on disaster management triggered by the earthquake of Sumatra and tsunami in 2004 to minimize damages proactively rather than reactively. GOSL had a plan to consolidate early warning system by preparing hazard maps of floods and landslides. Rapid preparation of hazard maps required efficient acquisition of accurate elevation data. The Laser Detection and Ranging (LiDAR) technology was the technology to acquire the data efficiently, but such technology was not available in Sri Lanka. GOSL, therefore, had to rely on conventional field surveys to acquire the data.</p>  |              |  |               |                 |                                       |   |                                   |  |  |  |
| Objectives of the Project                        | <p>This project aimed at production of LiDAR measurement raw data (7,800km<sup>2</sup>), Digital Elevation Model (DEM) <sup>1</sup> data (3,200km<sup>2</sup>)<sup>2</sup> and ortho-photo data (3,200km<sup>2</sup>)<sup>3</sup> for the areas prone to natural hazards such as floods and landslides in Sri Lanka as well as technical transfer on the methods of thematic map preparation based on DEM, thereby contributing to commencement of projects related to disaster prevention which utilize the DEM data prepared by the project, by way of utilization of the DEM data prepared by the project in project planning, formulation etc. related to disaster prevention.</p> <p>1. Expected Goals through the Proposed Plan<sup>4</sup>: Projects related to disaster prevention, which utilize the DEM data prepared by the project, are commenced.</p>   |              |  |               |                 |                                       |   |                                   |  |  |  |
| Activities of the Project                        | <p>1. Project Site : Districts of Colombo, Gampaha, Nuwara Eliya, Kegalle, parts of Kandy, Badulla and the surrounding area. (The area prone to floods, landslides, coastal erosion, etc. for LiDAR survey to acquire measurement raw data (7,800km<sup>2</sup>) and the area where natural disaster countermeasures were prioritized for DEM preparation (3,200km<sup>2</sup>.)</p> <p>2. Main Activities: Production of LiDAR measurement raw data, DEM data and ortho-photo data and technical transfer on the methods to prepare thematic maps based on the DEM.</p> <p>3. Inputs (to carry out above activities)</p> <table border="0"> <tr> <td>Japanese Side</td> <td>Sri Lankan Side</td> </tr> <tr> <td>(1) Members of Study Team: 11 persons</td> <td>(1) Staff Allocated: 35 persons from Photogrammetric Branch (22 persons), Mapping Branch (6 persons), GIS Branch (3 persons), Photo Laboratory (3 persons), Remote Sensing Branch (1 person) of SDSL.</td> </tr> <tr> <td>(2) Trainees Received: 15 persons</td> <td></td> </tr> <tr> <td>(3) Equipment: Personal computers, software etc.</td> <td></td> </tr> </table> |              |  | Japanese Side | Sri Lankan Side | (1) Members of Study Team: 11 persons | (1) Staff Allocated: 35 persons from Photogrammetric Branch (22 persons), Mapping Branch (6 persons), GIS Branch (3 persons), Photo Laboratory (3 persons), Remote Sensing Branch (1 person) of SDSL. | (2) Trainees Received: 15 persons |  | (3) Equipment: Personal computers, software etc. |  |
| Japanese Side                                    | Sri Lankan Side  |              |  |               |                 |                                       |   |                                   |  |  |  |
| (1) Members of Study Team: 11 persons            | (1) Staff Allocated: 35 persons from Photogrammetric Branch (22 persons), Mapping Branch (6 persons), GIS Branch (3 persons), Photo Laboratory (3 persons), Remote Sensing Branch (1 person) of SDSL.  |              |  |               |                 |                                       |   |                                   |  |  |  |
| (2) Trainees Received: 15 persons                |  |              |  |               |                 |                                       |   |                                   |  |  |  |
| (3) Equipment: Personal computers, software etc. |  |              |  |               |                 |                                       |   |                                   |  |  |  |
| Project Period                                   | January 2015 –December 2016  | Project Cost | (ex-ante) 451million yen; (actual) 424 million yen |               |                 |                                       |   |                                   |  |  |  |
| Implementing Agency                              | Survey Department of Sri Lanka (SDSL), Ministry of Land and Land Development   |              |  |               |                 |                                       |   |                                   |  |  |  |
| Cooperation Agency in Japan                      | Pacific Consultants Co., Ltd.; Oriental Consultants Global Co., Ltd.; Nakanihon Air Service Co., Ltd.; DMS Co., Ltd.   |              |  |               |                 |                                       |   |                                   |  |  |  |

**II. Result of the Evaluation**

<Special Perspectives Considered in the Ex-Post Evaluation>

-Indicator for Utilization Status of the Proposed Plan (i.e. Results of utilization of the DEM data, thematic maps etc. by the relevant organizations in project planning, formulation etc.) was interpreted as “Results of utilization of the DEM data, thematic maps etc. prepared by the project by the relevant organizations in project planning, formulation, etc. related to disaster prevention” in light of the description of the Expected Utilization of the Proposed Plan (i.e. The DEM data prepared by the project is utilized in project planning, formulation, etc. related to disaster prevention). Its target year was set to be 2019 because ex-post evaluation was planned after 3 years from the completion of the project as per the Ex-ante Evaluation Sheet.

-Indicator for Expected Goals through the Proposed Plan (i.e. Results of commencement of development projects which utilize the DEM data.) is interpreted as “Results of commencement of projects related to disaster prevention which utilize the DEM data prepared by the project” in light of the description of the Expected Goal through the Proposed Plan (i.e., Projects related to disaster prevention, which utilize the DEM data prepared by the project, are commenced).

1 Relevance

<sup>1</sup> High-precision digital elevation data.

<sup>2</sup> The initial DEM preparation area was 3,000km<sup>2</sup>. It was increased by 200km<sup>2</sup> based on the request of the implementing agency for the data for the additional area due to the large-scale flooding caused by heavy rain in the LiDAR survey area in May 2016. Amendment of the area was agreed in June 2016 by JICA and the Study Team and contract between JICA and the Study Team was amended accordingly.

<sup>3</sup> According to the Final Report (Summary) of the project, the ortho-photo preparation area is the same as DEM preparation area. It was increased from 3,000km<sup>2</sup> (i.e. the initial area at the time of commencement of the project) to 3,200km<sup>2</sup> in 2016 when DEM preparation area was increased from 3,000km<sup>2</sup> to 3,200km<sup>2</sup> as explained in footnote 2. For reference, the initial area for ortho-photo data was 7,800km<sup>2</sup> (same as the LiDAR survey area to obtain measurement raw data) according to the Record of Discussions (11/Sep/2014) and the Ex-ante Evaluation Sheet.

<sup>4</sup> The degree of achievement of expected goals is not to be assessed in principle at the time of ex-post evaluation, since it is defined as the medium-to-long-term goals which will be attained as a result of crystallizing the proposed plan (“output” of the project).

<Consistency with the Development Policy of Sri Lanka at the Time of Ex-Ante Evaluation>

The project was consistent with a policy of Sri Lanka for disaster prevention as set forth by Sri Lanka Disaster Management Act (2005), a fundamental framework for activities of mitigation, preparedness, response and recovery.

<Consistency with the Development Needs of Sri Lanka at the Time of Ex-Ante Evaluation>

The project was consistent with the development needs of Sri Lanka for LiDAR measurement data and DEM data for the areas prone to natural disasters as stated in <Background> above.

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

The project was consistent with Japan’s Country Assistance Policy to Sri Lanka (2012), which identified “Mitigation of vulnerabilities” as one of the priority areas under the basic policy of “Promotion of economic growth in consideration of merging regions”.

<Evaluation Result>

In light of the above, the relevance of the project is high.

2 Effectiveness/Impact

<Status of Achievement for the Objectives at the time of Project Completion>

The Objectives were achieved at the time of project completion. As planned, the LiDAR measurement raw data (7,800km<sup>2</sup>), the DEM data (3,200km<sup>2</sup>), and the ortho-photo data (3,200km<sup>2</sup>) had been produced before the project completion. Techniques on thematic map preparation based on DEM were transferred to the relevant staff members of SDSL (35 in total). The Final Report of the project was officially received/accepted as the project output by SDSL.

<Utilization Status of the Proposed Plan at the time of Ex-post Evaluation>

As expected at the time of project completion, the DEM data, ortho-photo data etc. prepared by the project were utilized by Disaster Management Center (DMC), Irrigation Department, National Building Research Organization (NBRO), and 7 municipalities in project planning, formulation, etc. related to disaster prevention. In addition, they were utilized by 3 other government organizations i.e., Central Engineering Consultancy Bureau (CECB), Central Environmental Authority (CEA), and Ministry of Megapolis and Western Development (MMWD) for project planning, formulation, etc. related to disaster prevention.

<Status of Achievement for Expected Goals through the Proposed Plan at the time of Ex-post Evaluation>

Progress was already observed towards the Expected Goals through the Proposed Plan, which are medium-to-long-term goals. To the knowledge of SDSL, at least 3 projects related to disaster prevention, which utilized the DEM data, ortho-photo data etc. were commenced/implemented by 3 government organizations i.e., Irrigation Department, CEA, and CECB.

<Other Impacts at the time of Ex-post Evaluation>

Various other positive impacts were observed. SDSL prepared the DEM data, ortho-photo data, and thematic maps for the remaining LiDAR area, using the transferred techniques and the provided equipment. The data and maps were used by DMC and NBRO for disaster resilience. The DEM data, ortho-photo data, and thematic maps prepared during and after the project completion were utilized for the purposes other than disaster prevention. For example, they were used by National Water Supply and Drainage Board (NWSDB), Urban Development Authority (UDA), and some local governments mainly for urban development and utility management. The DEM and ortho-photo data were also used to update 1:5,000 and 1:10,000 scale topographic data layers required for multiple uses of the country such as land use, road construction, etc. There was a synergetic effect with a JICA’s technical cooperation project “Project for Capacity Strengthening on Development of Non-Structural Measures for Landslide Risk Reduction (Project Sabo)” (2019-2021) as the data from SDSL produced by this project was utilized in Project Sabo. Meanwhile, no negative impacts were observed.

<Evaluation Result>

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

Status of Achievement of Utilization Status of the Proposed Plan and Expected Goals through the Proposed Plan

| Aim  | Indicators   | Results   |                            |  |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
|--|--|---|----------------------------|--|--|-----|---------------------------|--|-----------------------|----------------------|--|------|----------|---|------------------|----------|-----------------------|------|----------------------------|--|-----|-------|----------------------------------|------|----------|-------------------------------|
| (Utilization Status of the Proposed Plan)<br>The DEM data prepared by the project in project is used in project planning, formulation etc. related to disaster prevention. | Results of utilization of the DEM data, thematic maps etc. by the relevant organizations in project planning, formulation etc.<br><br>(Please see <Special Perspectives Considered in Evaluation>) | (Ex-post Evaluation) achieved.  |                            |  |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
|  |  | <table border="1"> <thead> <tr> <th>Organization</th> <th>Data/maps used</th> <th>Projects, activities, etc. in which data/maps were used in planning*</th> </tr> </thead> <tbody> <tr> <td>DMC</td> <td>DEM data, orthophoto data</td> <td>Risk Profile Project (2016-2025), flood and landslide disaster prevention, preparedness and post disaster operations</td> </tr> <tr> <td>Irrigation Department</td> <td>LiDAR data, DEM data</td> <td>Part of Comprehensive Climate Resilience Improvement Project (CRIP) (2014-present), flood modeling project</td> </tr> <tr> <td>NBRO</td> <td>DEM data</td> <td>Upcountry Landslide Resilience Project (2016-present)</td> </tr> <tr> <td>7 municipalities</td> <td>DEM data</td> <td>Updating of town maps</td> </tr> <tr> <td>MMWD</td> <td>DEM data, ortho-photo data</td> <td>Flood prevention and infrastructure development projects</td> </tr> <tr> <td>CEA</td> <td>ditto</td> <td>Land degradation mapping project</td> </tr> <tr> <td>CECB</td> <td>DEM data</td> <td>Flood modeling project (2017)</td> </tr> </tbody> </table> | Organization               | Data/maps used   | Projects, activities, etc. in which data/maps were used in planning* | DMC | DEM data, orthophoto data | Risk Profile Project (2016-2025), flood and landslide disaster prevention, preparedness and post disaster operations | Irrigation Department | LiDAR data, DEM data | Part of Comprehensive Climate Resilience Improvement Project (CRIP) (2014-present), flood modeling project | NBRO | DEM data | Upcountry Landslide Resilience Project (2016-present) | 7 municipalities | DEM data | Updating of town maps | MMWD | DEM data, ortho-photo data | Flood prevention and infrastructure development projects | CEA | ditto | Land degradation mapping project | CECB | DEM data | Flood modeling project (2017) |
|  |  | Organization  | Data/maps used             | Projects, activities, etc. in which data/maps were used in planning*   |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
|  |  | DMC   | DEM data, orthophoto data  | Risk Profile Project (2016-2025), flood and landslide disaster prevention, preparedness and post disaster operations |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
|  |  | Irrigation Department   | LiDAR data, DEM data       | Part of Comprehensive Climate Resilience Improvement Project (CRIP) (2014-present), flood modeling project           |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
|  |  | NBRO  | DEM data                   | Upcountry Landslide Resilience Project (2016-present)  |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
|  |  | 7 municipalities  | DEM data                   | Updating of town maps  |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
|  |  | MMWD  | DEM data, ortho-photo data | Flood prevention and infrastructure development projects   |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
| CEA  | ditto  | Land degradation mapping project  |                            |  |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
| CECB   | DEM data   | Flood modeling project (2017)   |                            |  |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
| *SDSL did not have information of the exact name and period of most of the projects, activities, etc.  |  |   |                            |  |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |
| (Expected Goals through the Proposed Plan)<br>Projects related to disaster prevention, which utilize the DEM data prepared by the project, are commenced.                  | Results of commencement of development projects which utilize the DEM data.<br><br>(Please see <Special Perspectives Considered in Evaluation>)  | (Ex-post Evaluation) partially achieved.<br>-To the knowledge of SDSL, at least 3 projects related to disaster prevention, which utilized the DEM data, ortho-photo data etc. were already commenced/implemented (i.e., flood modeling projects by CECB and Irrigation Department, and land degradation mapping project by CEA).* *SDSL did not have the information on the year of commencement/implementation.  |                            |  |  |     |                           |  |                       |                      |  |      |          |   |                  |          |                       |      |                            |  |     |       |                                  |      |          |                               |

Source: SDSL

3 Efficiency

Both project period and cost were within their respective plans (ratio against the plan: 100% and 94% respectively). The outputs were produced as planned. Therefore, the efficiency of the project is high.

#### 4 Sustainability

##### <Policy Aspect>

Sri Lanka Disaster Management Act (2005) stated in “Relevance” was still effective. In addition, Sri Lanka Sustainable Development Act (2017) set forth development and implementation of holistic disaster risk management at all levels in line with the Sendai Framework for Disaster Reduction (2015-2030).

##### <Institutional/Organizational Aspect>

Organizational structure of SDSL to prepare DEM and thematic maps from DEM data remained unchanged. The number of staff allocated to 5 relevant branches of SDSL was 25 in total (Photogrammetric Branch (17), Mapping Branch (2), GIS Branch (3), Photo Laboratory (2), and Remote Sensing Branch (1)). As compared with the project completion, the number of the relevant staff was decreased by 10 persons due to internal transfer (5) and retirement or resignation (5). According to SDSL, the number of staff of the 5 branches was appropriate to prepare DEM and thematic maps from DEM data as problems associated with insufficient manpower were not observed. SDSL continuously shared information with user organizations of DEM data and thematic maps from DEM data to promote their utilization. In order to enhance it, SDSL started to utilize National Spatial Data Infrastructure (NSDI)<sup>5</sup> launched in 2019 (the details could not be confirmed).

##### <Technical Aspect>

SDSL sustained technical capacity to prepare DEM data and thematic maps from DEM data through daily operation by the existing staff members trained by the project. For example, SDSL prepared DEM data and thematic maps of the remaining LiDAR area by themselves as stated in <Effectiveness/Impact>. The transferred techniques on preparation of an airborne LiDAR survey plan, however, were not utilized as the surveys outside the LiDAR survey area of the project were not conducted by SDSL due to lack of budget (see <Financial Aspect> below). It is noted that SDSL does not have internal training mechanism to transfer the acquired techniques in case new staff members join the relevant branches. SDSL mentioned that it would consider it in the future. SDSL also mentioned that they did not know how to update the transferred knowledge on the LiDAR technology in the future.

##### <Financial Aspect>

According to SDSL, it secured the necessary budget to prepare DEM data and thematic maps from DEM data as part of its regular budget allocated by the national government. A LiDAR survey, which was new to SDSL, was not part of their regular operation and, therefore, required additional budget. SDSL keened to conduct the surveys outside the LiDAR survey area of the project but it was not able to secure the additional budget for them.

##### <Evaluation Result>

In light of the above, slight problems have been observed in terms of the technical and financial aspects of the implementing agency. Therefore, the sustainability of the effectiveness through the project is fair.

#### 5 Summary of the Evaluation

The project achieved its Objectives at the time of project completion because the LiDAR measurement raw data (7,800km<sup>2</sup>), the DEM data (3,200km<sup>2</sup>), and the ortho-photo data (3,200km<sup>2</sup>) were produced and the methods on thematic map preparation based on DEM were transferred to the relevant staff members of SDSL. Utilization of the Proposed Plan was achieved because the DEM data, thematic maps, etc. were utilized by 6 government agencies and 7 municipalities in planning projects related to disaster prevention. Regarding the sustainability, slight problems were observed in terms of the technical and financial aspects mainly because the additional funds for LiDAR survey were not secured so that the transferred knowledge on LiDAR survey planning was not utilized. Nevertheless, no problem was observed in the policy and institutional/organizational aspects. Considering all of the above points, this project is evaluated to be highly satisfactory.

### III. Recommendations & Lessons Learned

#### Recommendations for Implementing Agency:

- It is recommended that SDSL secure budget for LiDAR surveys outside the LiDAR areas of the project by government or donor funds so that the transferred techniques on LiDAR survey planning will be continuously utilized.
- If new staff members join the relevant branches in the future, SDSL should make sure the transferred techniques and materials of the project be shared to them by on-the-job training in order to sustain the knowledge,

#### Lessons Learned for JICA:

-In a project involving technical transfer of the state-of-art technology such as LiDAR technology, action plans for updating the relevant knowledge should be prepared so that the implementing agency can continuously utilize the transferred knowledge even the technology is updated. During project implementation, JICA should consider this point and consultant should discuss with the implementing agency how they would be able to update their knowledge; ex. sharing some information resource they would be able to get the latest know how (technology), introducing and suggesting to the implementing agency to participate in some groups which teach them the latest know how etc.

<sup>5</sup> NSDI is a platform of geospatial information in Sri Lanka, which aims to create an ecosystem where government and private sector organizations can collaborate to manage, improve and exchange spatial data and information.