Date of Submission	29th August 2024 and further revised on 31st December, 2024

IPL Project Proposal 2024

1. Project Title:

ZONING OF POTENTIAL ROCKSLIDE DISASTERS TRIGGERED BY SEISMICITY IN THE KOTMALE RESERVOIR AREA, SRI LANKA

    (1) <u>**New project**</u>

    (2) Second stage of ongoing project

2. Main Project Fields

Select the suitable topics. If no suitable one, you may add new field.

    (1) <u>**Technology Development**</u>

        A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

    (2) Targeted Landslides: Mechanisms and Impacts

        A. Catastrophic Landslides, B. Landslides Threatening Heritage Sites

    (3) <u>**Capacity Building**</u>

        A. Enhancing Human and Institutional Capacities

        B. Collating and Disseminating Information/ Knowledge

    (4) Mitigation, Preparedness and Recovery

        A. Preparedness, B. Mitigation, C. Recovery

3. **Name of Project leader Dr. Jagath Gunatilake**

Affiliation: Senior Lecturer, Department of Geology / Postgraduate Institute of Science (PGIS)

        Team Leader, World Center of Excellence (WCOE), Engineering Geology and Research Group (EREG), University of Peradeniya

        Contact: Department of Geology, University of Peradeniya, Kandy, Sri Lanka.

        Fax   - +94 812394719

        Phone   - + 94 77 731 3063

        Email   - jagathpgis@gmail.com, jagath@sci.pdn.ac.lk

Core members of the Project

- Prof. K Sassa, Research Adviser, Secretory General/ICL, Kyoto, Japan
- Mr. A A Virajh Dias, Deputy Team Leader of WCOE-EGRG / PhD candidate, Postgraduate Institute of Science (PGIS), University of Peradeniya, Kandy, Sri Lanka
- Prof. Sanjeewa Malaviarachchi, Department of Geology, University of Peradeniya, Kandy.
- Sri Lanka
- Ms. S V Gunatilake, University of Adelaide, Adelaide, Australia
- Mr. Thilan Senevirathna, Research Assistant, Postgraduate Institute of Science (PGIS),, University of Peradeniya, Kandy, Sri Lanka
- Mr. Prabhath Gunatilake, PhD candidate, Postgraduate Institute of Science (PGIS), University of Peradeniya, Kandy, Sri Lanka
- Prof. Nanda Balasooriya, Head, Department of Geology, University of Peradeniya, Kandy, Sri Lanka

4. **Objectives**:

The primary goal is to assess the potential risk of landslides in the Kotmale reservoir area induced by seismic activity. This will be achieved through a comprehensive analysis incorporating geomorphological, geological, geophysical, and seismological studies and mapping. Additionally, the project emphasizes a multi-faceted approach that involves gathering and disseminating knowledge, integrating advanced technologies, enhancing capacity development, and fostering international collaboration.

5. **Background Justification**:

Understanding and reducing the risk of landslide-induced tsunamis, especially those caused by Earthquake/Tsunami-triggered landslides, is a primary goal of the Kyoto Landslide Commitment 2020 (KLC2020). The Mahaweli Authority of Sri Lanka (MASL) and the International Consortium of Landslide (ICL) jointly submitted a concept paper to the External Resources Department of Sri Lanka to initiate a Japan-Sri Lanka project on "Landslide Disaster Risk Identification and Planning of Risk Reduction Measures in the Central Mountainous Area of Sri Lanka," focusing on earthquake-triggered landslides in the Kotmale dam in July 2024. Landslide risk in the dam reservoir is a significant global issue for sustainable development (SDGs and the Sendai Framework) beyond just the Kotmale dam and downstream areas including Kotmale Training center and villages. Therefore, people living in and around the Kotmale reservoir area who are directly at risk from landslides and seismic activity. Enhanced risk assessment can help them prepare for and mitigate potential landslides disasters.

6. **Study Area**:   Kotmale dam and reservoir area; seismicity consideration for area bounded by minimum of 50km radios measured from the Kotmale dam

7. **Project Duration**: 5 years (2025 to 2030)

8. **Resources necessary for the Project and their mobilization**

   Personnel: Engineering Geology Research Group (EGRG) mainly from Postgraduate researchers (Doctoral, Master reach students), GIS research group, University of Peradeniya.
   Researchers from the ICL, Kyoto, Japan.

   Facilities: Engineering Geology Laboratory-Department of Geology, GIS Laboratory-Department of Geology, Seismic data recording center, University of Peradeniya

   Budgets: Research allocations from the postgraduate Research studies
   Additional funding through Research grants (possibilities are National Science Foundations (NSF), Sri Lanka and National Research Council (NRC), Sri Lanka)

9. **Project Description**: (30 lines maximum)

The Kotmale Dam is a large hydroelectric and irrigation dam in Kotmale, Sri Lanka. The dam generates power from three 67 MW turbines, with a total installed capacity of 201 MW, making it the second largest hydroelectric power station in Sri Lanka. Construction on the dam began in August 1979 and was ceremonially completed in February 1985. The Kotmale Dam reservoir, located in the central mountainous area of Sri Lanka, is at significant risk of landslides due to its geological, geomorphological, hydrological and seismological

characteristics. The increasing frequency of extreme weather events and seismic activities further exacerbates risks in reservoir impounding area which may have a threat of landslide. When landslides occur near reservoirs, the potential for disaster significantly increases due to the interaction between the landslide mass and the water body. Such events can result in substantial changes to the reservoir's stability and safety. Landslide towards reservoir is considers as a high-risk event according to the world records of disasters. When those rockslides are triggered by earthquakes (in addition to pore water pressure inside the slope), and these huge rockslide masses enter into the reservoir, water in the reservoir shall overtop the dam and attack the downstream.

The NBRO-ICL installed four seismographs around the Kotmale Reservoir in July 2024 and began monitoring on 29 July 2024. The X, Y, and Z components of the earthquake that occurred at 08:49 hrs on 8 August 2024 (SLST), monitored by the velocity seismometer and acceleration seismometer at the Kotmale International Training Institute, showed a Ts-p value of 0.5. This indicates that the hypocenter is located approximately 4 km from the Kotmale International Training Institute. The earthquake acceleration of the Z-component was significantly larger compared to the X- and Y-components, suggesting that the seismic source is located about 4 km below the Kotmale International Training Institute. Therefore, identifying potential zoning of seismicity induced disaster risk from large rockslides or landslide-induced tsunamis in the Kotmale reservoir, is an urgent issue for Sri Lanka. Therefore, a comprehensive investigation for seismicity measurements, interpretation, risk identification and planning of risk reduction is a timely and critical task for the country. This project aims to comprehensively identify landslide disaster proven zoning due to induced seismicity and develop effective methodology for the monitoring and interpretation of seismicity measures to ensure the safety and resilience of the Kotmale Dam and its surrounding areas.

10. **Work Plan/Expected Results**:

The proposed work plan is designed to provide a comprehensive, multi-disciplinary approach to assessing and zoning of potential rockslides induced by seismicity in the Kotmale reservoir area, with a strong emphasis on collaboration, capacity building, and the integration of advanced technologies. Works study of the area, collecting compressive data base on geomorphology, geology, seismographic data, geotechnical investigation data (old data and ongoing data), hydrological characteristics of the Kotmale reservoir area.

Year 2025 to 2026
- Comprehensive review report of findings, identify data inventory and gaps.
- Detailed surveys for geological mapping and geomorphological analysis. Seismic hazard analysis using historical data and probabilistic models.
- Technological Collaboration: Establish a network of engineers/practitioner/policymaker from both Sri Lanka and international institutions to facilitate ongoing collaboration and information exchange.
- Publication of finding at the Open Access Book Series P-LRT – 2026.

Year 2027 to 2028
- Data integration and analysis using GIS and specialized software.
- Development of landslide susceptibility maps.
- Scenario analysis of potential landslide events under different seismic conditions.
- Technological Collaboration: Establish a network of engineers/practitioner/policymaker from both Sri Lanka and international institutions to facilitate ongoing collaboration and information exchange.
- Publication of finding at the Open Access Book Series P-LRT – 2027/28

Year 2029 to 2030

- Resource Development: Create educational materials and resources, such as manuals and online platforms, to support ongoing learning and capacity development.
- Human Resource Training: Implement programs to train human resources in stakeholder institutions, including universities and technological centers, focusing on landslide and seismic risk management.
- Stakeholder Engagement: Organize regular meetings and workshops with stakeholders to review progress, share findings, and refine strategies.
- Publication of finding at the Open Access Book Series P-LRT – 2029/30.

11. Deliverables/Time Frame:

    Year 2025 to 2026

    Interpretation of stability potential through various appropriate hazard assessment methodologies including geomorphological, geological and histological data

    – Publication of finding at the Open Access Book Series P-LRT – 2026.

    Year 2027 to 2028

    Interpretation of seismotectonic model of the Kotmale reservoir area and report on seismic hazard analysis.

    – Publication of finding at the Open Access Book Series P-LRT – 2027/28.

    Year 2029 to 2030

    Further assessment of potential impact of seismicity on slope stability and landslide initiation at the Kotmale reservoir area and identify high-risk zones and assess the potential consequences of landslides.

    – Publication of finding at the Open Access Book Series P-LRT – 2029/30.

12. **Project Beneficiaries**:

    - Residents/Farmers: Kotmale Training Center, People living in and around the Kotmale reservoir area who are directly at risk from landslides and seismic activity. Enhanced risk assessment can help them prepare for and mitigate potential disasters.
    - Disaster Management Center (DMC): This agency will benefit from the assessment by gaining detailed information to improve disaster preparedness and response strategies.
    - National Building Research Organization (NBRO): This organization can use the findings to enhance its research on landslides and integrate the data into broader national risk assessments.
    - Ministry of Irrigation and Water Resources: Responsible for the Kotmale reservoir, this ministry can use the assessment to protect the reservoir infrastructure and ensure water resource management is not compromised by landslides.
    - Universities and Research Centers: These institutions can benefit from the data and findings for further research in geology, seismology, and disaster management. It can also provide opportunities for academic collaborations and advanced studies.

13. **References**

    1. Simulation video of the large-scale rockslide in the Kotmale dam reservoir (made by Sassa and Doan). The landslide-induced tsunami water overtops the Kotmale dam and reaches to a village including the International Training Institute of Irrigation and Water Management.
    https://drive.google.com/file/d/1nsikP-015oK6zBq9e42sI8vXWN-SZlfI/edit

2. Abayakoon, S. B. S. (1996). "Seismic Risk Analysis of Sri Lanka", Journal of Geological Society of Sri Lanka (GSSL), 6, 65-72.

3. Seneviratne, H.N., Perera, L.R.K., and Wijesundara, K.K., Origin of Recent Microseismicity Around Digana, Sri Lanka from Seismic Modelling, Proceedings of the 37th Technical Session of Geological Society of Sri Lanka, 2021; Published Online – 25th   February 2021.

Note: KLC secretariat <klc2020@landslides.org> and ICL Network <icl-network@landslides.org>