SATREPS

RRLL Newsletter

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スリランカにおける降雨による高速長距離土砂流動災害の早期警戒技術の開発
Development of early warning technology for rain-induced rapid and long-travelling landslides in Sri Lanka

ICL has invited SATREPS-RRLL members to visit Japan for ICL 20 th Anniversary and the 2022 ICL-KLC Hybrid Conference.

Date: December 2022

The Japan training was linked to the visit to the Kyoto Landslide Commitment 2020, organized by the International Consortium of Landslides (ICL). The event was at the Kyoto University Centennial Clock Tower Building in Kyoto, Japan. The programme contained associated field visits to several landslide risk mitigation sites.

The following officers from National Building Research Organization (NBRO) participated in the visit.

I. Eng. (Dr) Asiri Karunawardena – Director General
II. Dr H.A.G Jayathissa – Director of Landslide Risk Mitigation and Management Division
III. Mr K.N Bandara - Director the of Geotechnical Engineering Division
IV. Mr Dayan Munasinghe- Senior Scientist at Human Settlements Planning and Training Division
V. Mr D.M.D.S. Dissanayake – Scientist/ at Geotechnical Engineering Division
VI. Mr Buddhika – Scientist (Engineer) /Geotechnical Engineering Division

Key Highlights of the Japan Visit

Kyoto Landslide Commitment 2020

The Kyoto Landslide Commitment 2020 (ICL-KLC Conference) was held from November 22 to November 25, 2022. Ninety-five members participated in the conference in person, while a few others joined online. The ICL has been funded for several projects in different countries, and the progress and outcomes of each of the current projects were presented at the beginning of the session. In the same session, the NBRO presented the key project activities, including the current progress and technical output related to the RRLL project of the SATREP project. During the technical sessions, several researchers presented their research activities, and comments and suggestions were made for each paper, as is typical for a conference. The conference concluded on November 25, 2022, and the next conference is scheduled to be held in Italy or possibly Hong Kong next year.

Image 1 – Group photograph of the SATREPS team at ICL-KLC Hybrid Conference - 2022.

<u>Specific lesson learned</u>

The significance of a standardized early warning system for disasters Emergency management practices was made specific to community-based early warning systems as ISO 22328/2020 was introduced.

The Community-based Early Warning System Implementation Standards were mentioned together with the Implementation Methods and Implementation Procedure. Also, predicted difficulties were thoroughly covered.

After the technical session, a separate field visit to some of the places affected by geological risks that are related to the works carried out by the Sri Lankan counterpart was held from November 27 to December 1, 2022. The report of that trip is provided below.

<u>Highlights of the Key Field Visit During the Japan Visit</u>

1. **Miyajima's Momijidani River Sediment Control works**

A field visit was conducted in the park at Miyajima's Momijidani River to see the erosion control works in the historical period of Japanese civilization.

2. **Learning from ancient erosion control paradigms at Miyajima Island in Japan**

The landslides are common in Sri Lanka and Japan, which occurred for various reasons in both countries, significantly impacting the cities. The ancient civilization in Sri Lanka was linked to the dry zones, but the Japanese civilization was linked to mountainous regions. The reason was the geographic conditions of both countries- Sri Lanka has only 30% of the mountainous regions of the total land, but Japan has 80% of the mountainous regions. Therefore, erosion controls in Japan's ancient civilization significantly relate to landslide mitigation activities.

The Itsukushima shrine was built in the 12th century by Taira-no-Kiyomonri near Miyajima's Momijidani River on Miyajima Island, Hiroshima in Japan. The temple was not affected by the 'A-bomb' to Hiroshima, and the site has been declared a world heritage site in 1996. The shrine buildings showed the Japanese architecture style (Shinden zukuri style of the Heian Period (794-1184)) to understand the Japanese aesthetics and cultural links to the natural environment. The temple gate was located at the shallow seabed, which provides the identical structure for the shrine.

The temple has been affected by a sediment flow on September 17, 1945, by the Makurazaki typhoon that brought more than 170 mm daily rainfall in the area. Because of the granite soil structure of the mountains, a landslide occurred at the upper catchment of the river, and it was converted into a mudflow because of the continuous heavy rainfall at the time. As a result, Ryokan (inns), Momji Bridge and Itsukushima Shrine were affected by mudflow.

The prefecture and the local inhabitants were supported to restore the berried temple by applying erosion control measures to the Momijidani River.

Image 2 – Application of erosion control measures to the river bank and bed of Momijidani River.

They have used simple techniques to restore the area by considering the following conditions: no harm or damage to the larger rock boulders in the valley and existing trees, minimum usage of cement/ concrete for the construction, and covering the concrete surfaces by using natural materials, if in case of concrete are being used, and finally, apply a landscape planning for the entire valley to emphasise the aesthetic value of the location.

Five sediments control dams were created through this process, and later additional dams were created by the prefecture to prevent extreme events.

Image 3 – Sediments control dam (Type 1) in the Momijidani River.

Image 4 – Sediments control dams dam (Type 2) in the Momijidani River.

3. Site visit to Heisei Shinzan volcano museum and Unzen disaster museum

Mt. Heisei Shinzan is a volcano located in the Shimabara Peninsula of Kumamoto Prefecture, Japan. The volcano is also known as the "New Mountain of the Heisei era" because it emerged suddenly in 1990, during the Heisei era of the Japanese calendar.

Image 5 - Heisei Shinzan volcano museum *and Mt Heisei Shinzan Volcano at Shimabara, Kumamoto.*

Mt. Heisei Shinzan was formed by an eruption that occurred on November 12, 1990. Before the eruption, there were no signs of volcanic activity in the area. The eruption produced a large amount of ash and caused a lot of damage to the surrounding area.

Since then, the volcano has remained active, with occasional minor eruptions and volcanic tremors. Mt. Heisei Shinzan is closely monitored by the Japan Meteorological Agency, and access to the summit is restricted due to safety concerns.

Onokiba Sabo Miraikan, on the other hand, is a museum located in Minamishimabara, Nagasaki, Japan, that showcases the history and science of volcanic disasters. The museum is named after the Onokiba Sabo, which is a volcanic sediment control facility designed to prevent sediment and debris from flowing into populated areas during volcanic eruptions.

The museum features interactive exhibits and displays that allow visitors to learn about the science of volcanoes and the impacts of volcanic disasters on local communities. Visitors can also learn about the Onokiba Sabo and its role in protecting the surrounding area from volcanic hazards.

The Onokiba Sabo Miraikan Museum provides an opportunity for visitors to learn about the science of volcanoes and the strategies used to mitigate the risks associated with volcanic disasters.

Several historical events have been replicated on a physical model at the museum to observe the diverse impacts along the canal. The museum also houses several monuments of volcanic eruptions. As soon as reached the location, there was an underground exhibit made with volcanic eruption material. Various lighting setups were developed to highlight the audience's peril. The audience was then told to go to the auditorium for a brief movie. The ground alterations, way of life, and actions before and during the eruption were all properly presented in this brief film, which was made based on a story. The audience was led to a corridor that contains models of the leftover elements after the brief video, which focused on a few ruins left over from the volcanic explosion, finished. This corridor ended with a hall that included different gaming applications, which explained different concepts: SABO dams, the operation of remote excavators, remote cameras to monitor different mountain locations and many more. The number of microscopes located on the side of the hall focused on different soil samples and provides details of the volcanic soil types.

4. Landslide failures and countermeasures in the Aso Ohashi Bridge area and Koyadai Landslide

The Kumamoto Earthquake on April 16, 2016, caused significant slope damage in the Aso Ohashi Bridge area, resulting in the washout of National Road 57, JR Houhi Main Line, and Aso Ohashi Bridge which connects to National Road 57 (National Road 325) located at the base of the slope.

To mitigate the risk of further collapse due to rain and earthquakes, integrated approaches have been adopted taken using the latest unmanned construction technology.

Understanding the different types of mitigation measures and techniques that the Japanese have adopted is extremely valuable in enhancing Sri Lanka's landslide disaster mitigation mechanism

Image 6 – Photograph of the landslide just after the failure (Aso Ohashi Bridge area).

Several landslide mitigation mechanisms have been implemented by the Japanese government to reduce the impact of landslides. Some of these mechanisms are:

a. *Slope stabilization:* This mechanism involves stabilizing the slope using retaining walls, slope reinforcement with steel mesh, or stabilizing the ground with deep foundations.

b. *Drainage improvement*: Proper drainage systems are installed to reduce the buildup of water and prevent soil saturation, which is a common cause of landslides.

c. Land-use control: Land-use regulations and zoning laws are implemented to prevent construction on steep slopes or areas prone to landslides.

d. Forest management: Japan's forest management practices include the use of preventative measures such as thinning and removing dead or diseased trees, which helps to prevent landslides.

e. Early warning systems: Japan has implemented an early warning system to detect landslides and alert residents. The system uses sensors to

f. detect ground movement and sends alerts to residents.

These mechanisms have contributed significantly to reducing the impact of landslides in Japan. However, the country still experiences landslides, particularly during heavy rainfall and earthquakes. Therefore, ongoing efforts are necessary to ensure the safety of residents living in areas prone to landslides.

◆ Students from Sri Lanka were newly admitted to the Tokyo Institute of Technology and Yamanashi University.

Date: December 2022

Ms Anuththara Bandara

I am a graduate of the Department of Geology at the University of Peradeniya (UoP) with a Special Degree in Geology with Honors in 2015. In 2017, I began working as a geoscientist with the National Building Research Organization (NBRO) after one year of working as a demonstrator at the university. To date, I have been working in the Landslide Research and Risk Management Division (LRRMD) and have covered my duties actively and with much interest.

During this period, I have been engaged in consulting for landslide risk management activities such as landslide risk assessment for lands, buildings, and/or projects, identification of potential landslides, mitigation of landslides, awareness and education programs, community-based early warning system developments; and resettlement programs.

To knowledge capacity and career development, I started a master's degree in Engineering geology and hydrogeology at Post Graduate Institute of Science, UoP and earned the scholarship award for the highest Grade-Point-Average for 2018/2019 and waiting to complete of master's degree within September 2022 Based on my interest and hard work, I was fortunate to be selected for the ICL scholarship for the Master's Program at the Tokyo Institute of Technology (TIT) for the fall 2022 intake. My studies would be carried out under the supervision of Prof. Onishi Ryo in the Department of Mechanical Engineering, School of Engineering, TIT. I would like to express my sincere gratitude to JICA, JST, ICL, TIT, NBRO, and all the members of Project RRLL for their continuous support throughout.

Mr Sajith Bandaranayake

I am a Civil Engineer, who graduated in 2020 from the Department of Civil Engineering at the University of Moratuwa with a Second-class upper degree with honours. At the end of my graduate study, I came to realize that geotechnical engineering and its aspects are quite challenging, thereby a strong enthusiasm was built in my mind. To excel in my understanding and to practice the fundamental theories, I carried out research related to soil mechanics and did the design of the substructure section in the final year comprehensive design project and lead the team. The uniqueness of geotechnical-related problems pushed me to go forward with the same interest in my professional career. Upon graduation, I joined as a civil engineer in the Thambuttegama water supply project and expanded my knowledge and abilities by actively taking part as a civil engineer. During the construction time, I was involved in the designing of slope mitigation measures such as shoring systems, cut slopes and reinforced concrete walls in slope stability works.

In October 2022, I was supported by the ICL to undertake a master’s degree at the Department of Civil and Environmental Engineering, Yamanashi University. I believe that it will be a huge opportunity in my career, and I will gain knowledge at my best throughout the master's course. Finally, I would like to express my sincere gratitude to JICA, JST, ICL, Yamanashi University, NBRO and all members of project RRLLs

◆ Greetings from the project leaders

We have passed the middle of the five-year SATREPS Project. As one of the official events for a SATREPS project, we had the Interim Progress Review session held by the Japan Science and Technology Agency (JST) on January 30, 2022. Though we faced some difficulties in the implementation phase of our project in 2022, such as those due to the border restrictions in the COVID-19 pandemic and the economic crisis, such as power cuts and shortages of fuel, etc. that Sri Lanka has started experiencing since early 2022, the review committee gave us a good evaluation of "A." We got this excellent evaluation with the great helps and contributions that all relevant members, JICA officers, and JST officers had made. Of course, the committee has given us some requests to pursue our project further.

The requests included: (1) Refining the rain infiltration model considering the vegetation covers and land use, (2) Refining the social implementation protocols beyond the existing framework that had already been developed in the previous JICA Project SABO. Though not mentioned explicitly, we need to get the Augmented Reality (AR) software ready as soon as possible. Also, transferring the developed technologies is to be further accelerated. We thank you for your continued support.

Project Leaders

Prof. Kazuo Konagai

International Consortium on Landslides (ICL)

Eng. (Dr.) Asiri Karunawardena

National Building Research Organization (NBRO)