



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

◆ Events scheduled for this Fiscal year

Date: September 2022

1(a) Interim Progress Review

Since we are midway through our five-year project, our activities will be examined this year (Interim Progress Review with the Japan Science and Technology Agency (JST) as the hosting organization and JICA as the co-host). As part of this evaluation, an interim progress-report session will be held hybrid (in-person and online) in November, taking the good opportunity that some core JCC members on the Sri Lankan side will travel to Japan for the SATREPS Workshop in Kyoto. They will then conduct a field visit at important long-travelling landslide sites of Hiroshima, Unzen, and Aso. The provisional edition of our activity report was submitted in September 2022, and the final review session is scheduled for January 2023.

1(b) Itineraries for the Japanese missions

Another milestone of the SATREPS project going to happen from October to December 2022 at NBRO, Sri Lanka and as well as in two pilot sites in Aranayaka and Athweltota. Accordingly, the following activities are planned to be accomplished during the Japanese team visit.

- (1) Mr. Makoto Ishikawa, Mr. Masahiro Yoneda, Mr. Osamu Hiroi, Mr. Yuji Ikari and Mr. Taketoshi Marui
October 2022
Installation and initial testing of Ring Shear Apparatus at the Geotechnical Engineering laboratory premises of NBRO
- (2) Dr. Koichi Araki and Mr. Keisuke Takimoto
November 2022
Installation and setting up of the WS for AR software.
- (3) Dr. Ryo Onishi and Mr. Jo Hirai
November 2022
Installation and setting up of the WS for MSSG.
- (4) Dr. Satoshi Goto and Dr. Masataka Shiga (Sandaruwan Karunara and Dhanushka Jayathilaka)
November 2022
Soil sampling from pilot sites with the assistance of the NBRO team.
- (5) Dr. Shiho Asano, Mr. Hideki Iwakami, Mr. Shota Hayashida, Mr. Shogo Morita, and Mr. Tomonori Saito (Sanchitha Jayakody)
November and December 2022
Installation of measurement instruments at the two pilot sites with the assistance of the NBRO team.

1(c) Itineraries for the Sri Lankan missions

Apart from the above activities, ICL has invited SATREPS-RRLL members from Sri Lanka to take part in meetings, conferences, workshops, and field trips from the 21st of November to the 01st of December 2022. Activities scheduled for this visit will take place in Kyoto, Hiroshima, Kumamoto, and Tokyo. Eng (Dr.) Asiri Karunawardena (Project Leader (SATREPS-NBRO), Director General of NBRO), Dr. Gamini Jayathissa (Project Manager (SATREPS-NBRO), Director of Landslide Division, NBRO), Mr. K.N. Bandara (Group Leader – Working Group 1, Director of Geotechnical Engineering Division, NBRO), Mr. Suranga Dissanayaka, Mr. Buddhika Kumaraage, and Mr. Dayan Munasingha from NBRO, Dr. Jayalath Edirisinghe (a JCC member from the University of Peradeniya) and the supervisor of ICL-SATREPS office, Dr. Jagath Gunathilaka will be the representatives from Sri Lanka side. This visit will accomplish the project's goals while enriching the Japan – Sri Lanka collaboration toward future works.

◆ Joint Coordination Committee (JCC) meeting Jun 15, 2022

The 3rd JCC meeting was held in hybrid mode on 15th June 2022, under the chairmanship of Dr. Asiri Karunawardena, Director-General of NBRO. The participants shared their common understanding of the following areas:

(1) As the COVID-19 pandemic has caused a significant burden for the JCC members to drive the project forward, JCC has taken possible steps further ahead. The action that the members have taken mainly was the development of essential vital technologies. Not to mention the core members of each research group, international students from Sri Lanka, have

actively been involved in these activities. The activities yielded some significant achievements, such as a ground-breaking finding enabling a reliable forecast of cumulative rainfall in mountain terrain, etc.

(2) However, some actions requiring on-site surveys had not been well underway due to the strict border restriction amid the COVID-19 pandemic. These activities and their future actions are as follows:

- Even though the installation of a field observation system at the unstable soil masses perching atop the project's two pilot sites was delayed, the observation finally started at one of the sites, Athweltota, in March 2022. The other actions, including future social implementations, were also delayed due to COVID-19 border control. Since the border control has withdrawn, the Japanese members plan to visit Sri Lanka this year, 2022 for field visits and questionnaire surveys.
- In addition, the following activities are planned to start:
 - (a) Installation of the Ring-shear apparatus (Already completed)
 - (b) LS-Rapid Training Session: LS-Rapid is a software tool for numerical simulations of the initiation, downslope movement, and deposition of the fluidified slurry, and other activities deemed necessary.
- **ICL SATREPS office in Sri Lanka:** To facilitate logistics for the activities mentioned above and to comply with the Record of Discussion agreed upon between NBRO and JICA on 05th February 2020, NBRO and ICL

agreed that the ICL/SATREPS office opened on 15th June 2022 at NBRO.

- **Open Access Book Series "Progress in Landslide Research and Technology (P-LRT)":** ICL aimed to publish a new Open Access Book Series titled "Progress in Landslide Research and Technology (P-LRT)." This book series target readers and users who may be either practitioner or other stakeholder applying the most advanced knowledge of science and technology to reduce landslide disaster risk. Following this, three articles about Project RRLI have been accepted to appear in Volume 1, Issue 1.

<https://link.springer.com/article/10.1007/s10346-021-01759-6>

- **Recruiting new students:** Universities on the Japanese side will continue recruiting students for master's degrees, given the remaining period for the project. Currently, two students for master's degrees are supposed to be enrolled at the Tokyo Institute of Technology and Yamanashi University in the fall semester of 2022.

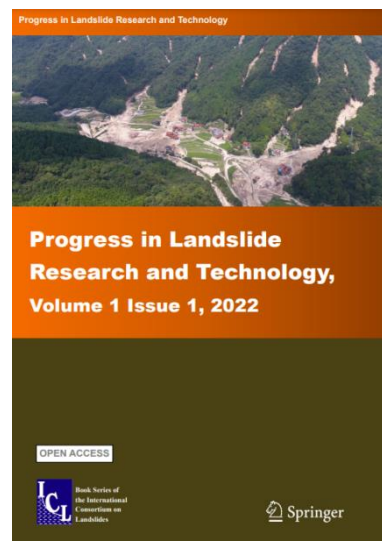


The 3rd JCC Hybrid Meeting at Disaster Prevention Research Institute, Kyoto University

◆ ICL's New open access book series

ICL started publishing a new Open Access Book Series "Progress in Landslide Research and Technology (P-LRT)". The application to the book Volume 2, Issue 2 is available by 30 October 2022.

<https://www.landslides.org/book-series-of-klc-2020/>



◆ Publications

Date: March 2022

- I. Qinwen Tan, **Kyoji Sassa, Khang Dang, Kazuo Konagai, Asiri Karunawardena, R. M. S. Bandara**, Huiming Tang, Go Sato. Estimation of the past and future landslide hazards in the neighboring slopes of the 2016 Aranayake landslide, Sri Lanka. *Landslides*, 2020, Vol. 17, 1727–1738.
- II. **Kazuo Konagai, Asiri Karunawardena, Kyoji Sassa**, "SATREPS Project for Sri Lanka with regard to "Development of Early Warning Technology of Rain-Induced Rapid and Long-Travelling Landslides," *Understanding and Reducing Landslide Disaster Risk*, a part of ICL Contribution to Landslide Disaster Risk Reduction book series (CLDRR), Vol. 1 Sendai Landslide Partnerships and Kyoto Landslide Commitment, 205-214, December 2020.
- III. Qunli Han, **Kyoji Sassa**, and Matjaz Mikos "International Programme on Landslides (IPL): A Programme of the ICL for Landslide Disaster Risk Reduction," *Understanding and Reducing Landslide Disaster Risk*, a part of ICL Contribution to Landslide Disaster Risk Reduction book series (CLDRR), Vol. 1 Sendai Landslide Partnerships and Kyoto Landslide Commitment, 187-204, December 2020.
- IV. Duc Ha Nguyen, Takahiro Sayama, Kyoji Sassa, Kaoru Takara, Ryosuke Uzuoka, Khang Dang, Tien Van Pham, "A Coupled Hydrological-geotechnical Framework for Forecasting Shallow Landslide Hazard—a Case Study in Halong City, Vietnam", *Landslides* 2019, Vol.17, No.7: 1619-1634. (online publication is 19 March 2020).
- V. **Kyoji Sassa**, Peter T. Bobrowsky, Kaoru Takara, and Badaoui Rouhban "Kyoto 2020 Commitment for Global Promotion of Understanding and Reducing Landslide Disaster Risk," *Understanding and Reducing Landslide Disaster Risk*, a part of ICL Contribution to Landslide Disaster Risk Reduction book series (CLDRR), Vol. 1 Sendai Landslide Partnerships and Kyoto Landslide Commitment, 145-154, December 2020.
- VI. Katsuo Sasahara: Velocity and Acceleration of Surface Displacement in Sandy model Slope with Various Slope Conditions, N. Casagli et al. (eds.), *Understanding and Reducing Landslide Disaster Risk*, ICL Contribution to Landslide Disaster Risk Reduction, pp.315-320.
- VII. Khang Dang, Doan Huy Loi, Kiyoharu Hirota, Yoshinobu Taniguchi & Kyoji Sassa, Landslide triggered by heavy rainfall on 06 September 2020 in Shiiba village, Miyazaki Prefecture, Japan. *Landslides* volume 18, pages3485–3488 (2021).
- VIII. Pham Van Tien, Le Hong Luong, Kyoji Sassa, Kaoru Takara, Maskey Sumit, Tran Thanh Nhan, Khang Dang, and Do Minh Duc (2021) Mechanisms and Modeling of the Catastrophic Landslide Dam at Jure Village, Nepal. *Journal of Geotechnical and Geoenvironmental Engineering* 147 (11).

- IX. Pham Van Tien, Le Hong Luong, Do Minh Duc, Phan Trong Trinh, Dinh Thi Quynh, Nguyen Chau Lan, Dang Thi Thuy, Nguyen Quoc Phi, Tran Quoc Cuong, Khang Dang & Doan Huy Loi, Rainfall-induced catastrophic landslide in Quang Tri Province: the deadliest single landslide event in Vietnam in 2020. *Landslides* volume 18, pages2323–2327 (2021).
- X. D. Hiruma, R. Onishi, K. Takahashi, and K. Fukagata, Sensitivity Study on Storm Modulation through a Strategic Use of Consumer Air Conditioners, *Atmospheric Science Letters* (accepted 2022/3/16).
- XI. Katsuo Sasahara, Nobutaka Hiraoka, Naotaka Kikkawa, Kazuya Itoh, "Development of the surface displacement velocity in a full-scale loamy model slope under multistep excavation", *Bulletin of Engineering Geology and the Environment*,2021.24,80-, pp.4389-4403.
- XII. Jiawei Xu, Kyohei Ueda, and Ryosuke Uzuoka, "Evaluation of failure of slopes with shaking-induced cracks in response to rainfall", *Landslides*,2022.01,191, pp.119-136.
- XIII. Kazuo Konagai, Asiri Karunawardena, A A Virajh Dias, Kyoji Sassa, Khang Dang, "Development of Early Warning Technology of Rain-induced Rapid and Long-travelling Landslides in Sri Lanka". *Proceedings of 2019 IPL Symposium on Landslides*, 16-19 September 2019, pp. 277-283. ISBN 978-4-9903382-5-1.
- XIV. Konagai K., Karunawardena A., Sassa K. (2021) SATREPS Project for Sri Lanka with Regard to "Development of Early Warning Technology of Rain-Induced Rapid and Long-Travelling Landslides". In: Sassa K., Mikoš M., Sassa S., Bobrowsky P.T., Takara K., Dang K. (eds) *Understanding and Reducing Landslide Disaster Risk*. WLF 2020. ICL Contribution to Landslide Disaster Risk Reduction. Springer, Cham. https://doi.org/10.1007/978-3-030-60196-6_12
- XV. Kazuo Konagai, Asiri Karunawardena, Kithsiri N. Bandara, Kyoji Sassa, Ryo Onishi, Ryosuke Uzuoka, Shiho Asano, Katsuo Sasahara, Sanchitha Jayakody, Imaya Ariyaratna, Early warning system against rainfall-induced landslide in Sri Lanka. *Progress in Landslide Research and Technology*, Vol.1, No.1.
- XVI. Khang Dang, Kyoji Sassa, Kiyoharu Hirota, Kazuo Konagai, Duc Ha Nguyen, Huy Loi Doan, "Preliminary Simulation for Kure Landslide Triggered by Heavy Rainfall of July 2018" *Proceedings of 58th Annual Meeting of Japan Landslide Society*, 21-22 August 2019, pp.81-82.
- XVII. Kyoji Sassa, Kazuo Konagai, Kiyoharu Hirota, Asiri Karunawardena, Japan-Sri Lanka SATREPS Project "Development of Early Warning Technology of Rain-induced Rapid and Long-travelling Landslides". *Proceedings of 58th Annual Meeting of Japan Landslide Society*, 21-22 August 2019, pp. 147-148.
- XVIII. **Khang Dang, Doan Huy Loi, Kyoji Sassa, Do Minh Duc, Nguyen Duc Ha.** Hazard assessment of a rainfall-induced deep-seated landslide in Hakha city, Myanmar. *Understanding and Reducing Landslide Disaster Risk* (Binod Tiwari,

Kyoji Sassa, Peter Bobrowsky, Kaoru Takara, eds). Springer, Cham. Vol. 4 Testing, Modeling and Risk Assessment, pp 249-257, 2021.

XIX. **Doan Huy Loi, Kyoji Sassa, Khang Dang,** Le Hong Luong. Landslide hazard zoning is based on the integrated simulation model (LS-Rapid). Understanding and Reducing Landslide Disaster Risk (Binod Tiwari, Kyoji Sassa, Peter Bobrowsky, Kaoru Takara, eds). Springer, Cham, Vol. 4 Testing, Modeling and Risk Assessment, pp 259-266, 2021.

XX. Kyoji Sassa, Matjaž Mikoš, Shinji Sassa, Peter T. Bobrowsky, Kaoru Takara, Khang Dang, eds. Understanding and Reducing Landslide Disaster Risk. Volume 1 Sendai Landslide Partnerships and Kyoto Landslide Commitment. Springer, Cham, 2021.

XXI. Kumiko Fujita "Introducing Japanese Landslide Warning System to Sri Lanka: Analyzing the Social Differences for Successful Technology Transfer" in Impact of Climate Change, Land Use and Land Cover, and Socio-economic Dynamics on Landslides. Disaster Risk Reduction (Methods, Approaches, and Practices). Springer, Singapore. Editors: Raju Sarkar, Rajib Shaw, and Biswajeet Pradhan, Springer, (2022) Pages 397-412 https://doi.org/10.1007/978-981-16-7314-6_17

◆ Greetings from the Group Leaders

Greetings from Dr. Kazuo Konagai- International Consortium on Landslides (ICL)

In this fiscal year 2022, we have embarked on the third-year stage of the roadmap toward the goals of the five-year SATREPS Project RRL. As it had been, COVID-19 continued to run its course in both Sri Lanka and Japan. Sri Lanka's inflation set a new record of 69.8% in September, up from 64.3% a month earlier. Regardless of these difficulties, we have taken possible steps further ahead. Our activities have successfully yielded some significant achievements, such as a groundbreaking finding enabling a reliable forecast of cumulative rains in rugged mountains. The ICL/SATREPS office opened on 15th June 2022 at NBRO to facilitate logistics for our activities. Now we are planning hybrid meetings, seminars, field surveys, etc., in Japan and Sri Lanka, given the eased border restrictions. These activities have not and will not exist without dedicated support from the project members and JICA and JST officers. We would like to take this moment to say thank you very much.

Greetings from Dr. Gamini Jayathissa Landslide Research and Risk Management Division (NBRO)

The third-year plan was started in 2022 to accomplish the five-year SATREPS Project objectives. Due to the country's political chaos and economic implications, the Japanese team's visit to Sri Lanka had to be postponed. Owing to this, Ring Shear Apparatus adjustment at NBRO, WS for AR software adjustments, measurement instruments installation at pilot sites, and soil monitoring at pilot sites were also postponed by SATREPS Project coordinators. Finally, the Japanese team will visit Sri Lanka from the mid of October to December from time to time in small groups. Of course, a new milestone of the SATREPS project will be then launched at NBRO and

pilot sites in Aranayaka and Athweltota at end of the October after installation of the Ring Shear Apparatus by Marui Company.

I must note that the ICL SATREP Sri Lankan office was established in late June and then long-delayed field measurements caused by the economic crisis were started again. And, We are proud to say that, two ICL scholarship opportunities for the MSc program were given to us, amongst one candidate selected for the Tokyo Institute of Technology (TIT) 2022 fall, and the other one for Yamanashi University. Continuous support was given all the time by officers of JICA, JST on the Japanese side, NBRO, CECB, University of Moratuwa, University of Peradeniya, Disaster Management Center, etc. on the Sri Lankan side to get the maximum out of this RRL project. Finally, on behalf of Project RRL, we would like to convey our sincere thanks to all collaborators from Sri Lanka and Japan.

Greetings from Dr. Shiho Asano- Forestry and Forest Products Research Institute (FFPRI)

Although there was a long period when the face-to-face exchange between the two countries was difficult due to travel restrictions, our groups for the development of early warning technology have conducted many research activities respectively. The joint research has been successful thanks to the active efforts of international students, including rainfall forecasting simulations by Professor Onishi and rainfall infiltration and landslide stability modeling by Professor Uzuraoka. The activities of our field monitoring group had been delayed due to travel restrictions, but the restrictions were finally relaxed and we were able to start field observations with the cooperation of many members on both the Japanese and Sri Lankan sides. For the development of early warning technologies for landslide disasters caused by heavy rainfall, it is important to clarify the actual relationship between rainfall, groundwater, and ground displacement

from field observations. For this purpose, we will work to further accelerate field observations in the future. We thank you for your past cooperation and look forward to your continued support.