Date of Submission	31 March 2023

IPL Project Annual Report 2022

January 2022 to 31 December 2022

1 Project Title: Development of Community-based Landslide Early Warning System in Indonesia (IPL 158)

2 Main Project Fields: Landslide Monitoring and Early Warning and the Implementation of Landslide Mitigation

3 Name of Project leader:

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Core members of the Project: Names/Affiliations: (4 individuals maximum)

a. Prof. Dwikorita Karnawati: Head of the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG), Indonesia (dwiko@bmkg.go.id)
b. Prof. Wahyu Wilopo – Vice Director of Center for Disaster Mitigation and Technological Innovation (GAMA-InaTEK), Geological Engineering Dept. Universitas Gadjah Mada.
c. Dr. Hendy Setiawan - Center for Disaster Mitigation and Technological Innovation (GAMA-InaTEK), Geological Engineering Dept. Universitas Gadjah Mada.
d. Dr. Fikri Faris - Center for Disaster Mitigation and Technological Innovation (GAMA-InaTEK), Civil & Environmental Engineering Dept. Universitas Gadjah Mada.

4 Objectives: (5 lines maximum)

- Community empowerment with respect to community-based disaster risk reduction in landslide vulnerable areas, by integrating technical and social system.
- Improvement of awareness, preparedness, and resilience of the community in facing disasters in order to create resilient villages, which is the root of the nation's resilience.
- Promotion of a global standard on landslide early warning system.

5 Study Area: (2 lines maximum): at 60 districts located in 30 provinces of Indonesia.

6 Project Duration (1 line maximum) : 2009 – 2022

7 Report

1) Progress in the project: (30 lines maximum)

The community-based landslide monitoring and early warning system (EWS) has been developed in Indonesia since 2007. This research project was initiated and supported by ICL. This activity is monitored and evaluated annually, to provide a solution for the problem faced during its implementation. The coordination between the central government – local government, universities, private companies, and the communities plays an important role in realizing the effective and sustainable program. A strategic approach for landslide disaster risk reduction is developed through the promotion of monitoring and information flow and command system.

Several monitoring devices and warning services were developed involving a simple and low-cost equipment to high technology equipment using a telemetry system for data transfer. The monitoring devices comprise the sensor to measure rainfall intensity, surface deformation, slip surface deformation, infiltration rate, and pore water fluctuation in the sliding mass. These devices provide an online monitoring and could be accessed in a webserver. This system can be adjusted depending on the site conditions.

From January 2022 to December 2022, the landslide EWS were implemented in 60 districts at 30 provinces in Indonesia, with the financial support from the Indonesian Authority for Disaster Management (BNPB) and private sectors. A landslide evacuation drill was carried out in each location as an effort to establish a disaster ready community. The simulation was a training for the Disaster Preparedness Team and was carried out by following the Standard Operating Procedure and evacuation map developed prior to the simulation. The early warning system has been developed not only for landslides, but also for other disasters i.e. flood, debris flow, volcanic eruption and tsunami.

2) Planned future activities or Statement of completion of the Project (15 lines maximum)

This landslide monitoring and early warning device will be further developed, by implementing them in several pilot sites including in Papua, Sulawesi and Kalimantan Islands in Indonesia and other countries and evaluating their technical performance as well as the impact to the community. The results of the evaluations will be used to facilitate the enhancement of the system performance. Furthermore, the International Standard of Guidelines for the Implementation of Community-based Landslide Early Warning System (ISO 22327:2018) initiated by Universitas Gadjah Mada, The Indonesian Authority for Disaster Management (BNPB) and Indonesia Standardization Agency (BSN) will continue to be developed in other countries.

3) Beneficiaries of Project for Science, Education and/or Society (15 lines maximum)

Various potential beneficiaries of the project may be achieved including strengthening international partnership and good cooperation among related institutions. Besides, the integration of this

monitoring and warning system is very important. This is because some institutions might have their own systems, but not yet integrated with the other monitoring system. A national framework needs to be promoted to manage all of landslide monitoring systems in Indonesia. By this integration, the landslide monitoring and early warning system at national-provincial-district level could be improved and work properly.

4) Results: (15 line maximum, e.g. publications)

Research papers published in journals or presented at conferences

1. Fathani, T.F., Karnawati, D., Wilopo, W., Setiawan, H. (2023). Strengthening the Resilience by Implementing a Standard for Landslide Early Warning System. In: Sassa, K., Konagai, K., Tiwari, B., Arbanas, Ž., Sassa, S. (eds) Progress in Landslide Research and Technology, Volume 1 Issue 1, 2022. Progress in Landslide Research and Technology. Springer, Cham. https://doi.org/10.1007/978-3-031-16898-7_20
2. Ajmera B, Ahari HE, Loi DH, Setiawan H, Dang K, Sassa K (2023) LS-RAPID manual with video tutorials. Progress in Landslide Research and Technology, Volume 1 Issue 1: 343-406. Springer, Cham. https://doi.org/10.1007/978-3-031-16898-7_26
3. Bukhari, M.H., da Silva, P.F., Pilz, J., Istanbulluoglu, E., Gorum, T., Lee, J., Karamehic-Muratovic, A., Urmi, T., Soltani, A., Wilopo, W., Qureshi, J.A., Zekan, S., Koonisetty, K.S., Sheishenaly, U., Khan, L., Espinoza, J., Mendoza, E.P., Haque, U. Community perceptions of landslide risk and susceptibility: a multi-country study. *Landslides* (2023). https://doi.org/10.1007/s10346-023-02027-5
4. Faris, F., & Fathani, T. F. (2022). The new digital infiltration profiler performance test on sandy soil. Environmental Earth Sciences, 81(23), 539.
5. Faris, F., & Adi, A. D. (2022). Height reliability-based analysis of woven bamboo mat reinforced mechanically stabilized earth wall in temporary railway embankment. *ASEAN Engineering Journal*, *12*(1), 189-196.
6. Fathani, T. F., Wilopo, W., Amalina, A. N., & Pramaditya, A. (2022). Debris Flow Hazard Analysis Toward The Implementation of Mitigation Measures. GEOMATE Journal, 23(95), 45–56.
7. Sekarlangit, N., Fathani T.F., W Wilopo, W. (2022). Landslide Susceptibility Mapping of Menoreh Mountain Using Logistic Regression, Journal of Applied Geology 7(2): 51-63
8. Rifa'i A., Ramadhani, S., Wilopo, W. (2022). The geological structure effects on slopes stability and tunnels of metamorphic rocks at Poboya gold mine Palu, Journal of Applied Eng. Science 20 (1), 1-12
9. Wilopo, W., Putra, D.P.E, Fathani, T.F., Widodo, S., Pratama, G.N.I.P., Nugroho, M.S., Prihadi, W.R. (2022) Identification of subsidence hazard zone by integrating engineering geological mapping and electrical resistivity tomography in Gunung Kidul karst area, Indonesia, Journal of Degraded and Mining Lands Management 9 (2), 3281-3291
10. Erzagian, E., Wilopo, W., Fathani, T.F. (2023) Landslide Susceptibility Mapping Using Frequency Ratio Method in Kulon Progo Mountains Area, Indonesia. Progress in Landslide Research and Technology, Volume 2 Issue 2, 2023