

## IPL Project (IPL - 211) Annual Report Form 2017

1 January 2016 to 31 December 2016

1. Project Number (approved year) and Title :

IPL-211 (2016) Development of Wireless Sensor Network for Monitoring and Earlier Warning of Shallow and Deep Landslides (WISE-LAND)

2. Main Project Fields :

(1) Technology Development

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) Capacity Building

~~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. AdrinTohari

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Core members of the Project:

(1) Arifan Jaya Syahbana, M.Eng/ Research Center for Geotechnology, Indonesian Institute of Sciences

(2) Suryadi/ Research Center for Physics, Indonesian Institute of Sciences

(3) Mohamad Imam Afandi/ Research Center for Physics, Indonesian Institute of Sciences

4. Objectives: the main objective of this project is to develop a low-cost wireless sensor network applicable for monitoring of shallow and deep landslides in order to establish an effective landslide earlier warning system. This objective will be achieved by developing a prototype of a wireless sensor module for many types of sensor and gateway and by conducting a field test to evaluate and improve the developed wireless sensor module network.

5. Study Area: the project will be conducted in highly landslide prone residential areas in Bandung

and **Purwakarta** District, West Java. The selection of study areas will be based on the landslide susceptibility assessment.

6. Project Duration: 4 years. Two years for research and development of sensor network, and two year for implementation of wireless sensor networks. The project has been started in 2015.

## 7. Report

- 1) Progress in the project:

The 2016 project activities have been focused on developing a prototype of wireless sensor modules, gateway and data acquisition software for different types of sensors.

The developed wireless sensor modules have a maximum distance communication of 300 m and facilitate with 4 channels of analog input and 2 channels of digital input. So, the sensor modules can be connected to a rain-gage, two soil moisture sensors, and two pore-water pressure sensors. One set of sensor modules are also equipped with built-in two axial tiltmeters. The communications among sensor modules uses the Xbee pro module. Each sensor module is powered by a 12 V/12 Ah battery via a solar panel.

The wireless gateway has been developed to receive data from sensor modules and transmit all data to server. The data transmission from sensor module to the gateway is established using the Xbee pro module. Meanwhile, GPRS module is used for communication between gateway and server. The gateway is powered using a battery of 12 V/55 Ah via a solar panel

Data acquisition software was developed to analyze and establish data base in graphic and tabular forms. All real-time and historical data can be accessed via the following website: <http://lipi-wiseland.com> (user name : user; password : userpass).

Field testing of prototype WISE-LAND also has been conducted in 2016 at two landslide hazard locations through cooperation with Disaster Management Agency of Bandung District and Indonesia Highway Cooperation to reduce landslide risk in a residential area in Pangalengan Village of Bandung District, West Java (Fig. 1) and at a cut-slope along a toll road at KM 100 in Purwakarta District, West Java (Fig. 2). From the field testing program, some problems were recognized with regard to power supply in sensor modules and data acquisition system. The problem with power supply is solved by installing a solar panel with a bigger charging capacity. Meanwhile, the problem with data acquisition system is associated with the quick data transmission interval. So, a new data transmission interval was set to filter the unnecessary data.

- 2) Planned future activities or Statement of completion of the Project :

The project activity in 2017 consists of (1) field testing of prototype of wireless sensor network in order to verify its capability to measure the various soil parameters, such as water content,

pore-water pressures, displacement in different landslide types and slope conditions, and (2) improvement of data acquisition and transmission for more accurate monitoring system. At the completion of the project in 2018, the developed WISE-LAND will be implemented in other landslide prone areas in West Java in cooperation with other agencies and railway/ highway companies.

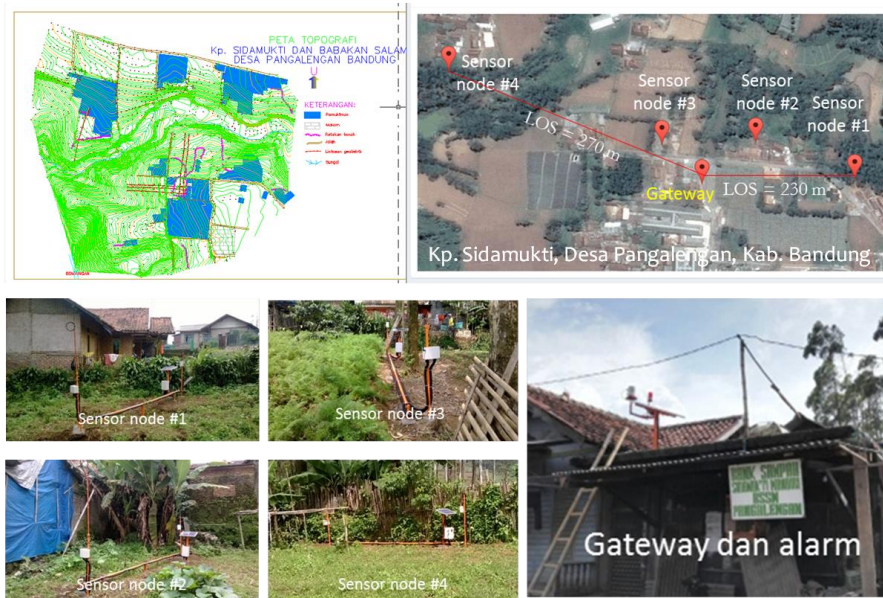


Fig. 1. Prototype of WISE-LAND installed at Pangalengan Village, Bandung District, West Java. The system consists of 4 sensor modules, 4 wire extensometers and 1 gateway with raingage and alarm.



Fig. 2. Prototype of WISE-LAND installed at Cipularang toll road KM 100, Purwakarta District, West Java. The system consists of 4 sensor modules, 4 wire extensometers, 8 tiltmeters and 1 gateway with raingage and alarm.

3) Beneficiaries of Project for Science, Education and/or Society:

The 2016 WISE-LAND project has promoted some innovations of physical electronic based instrumentation for landslide monitoring system.

The 2016 WISE-LAND project also established a cooperation activity between our institution and Disaster Management Agency of Bandung District and Indonesia Highway Corporation (PT. Jasa Marga). The local people, local disaster management office and the highway company can access the monitoring data to increase their awareness and preparedness on landslide hazard at each location.

The WISE-LAND project also aims to contribute to the development of reliable and effective monitoring system of landslide hazard in Indonesia.

4) Results:

The 2016 WISE-LAND Project has produced the following results

(a) 2 (two) sets of prototype of WISE-LAND, each set consists of 4 units of wireless sensor modules, 4 units of wireless wire-extensometer, 4 units of stand-alone wireless tiltmeters, one unit of wireless gateway with rain gage and warning system, and data acquisition software.

(b) Publications :

- Development of Wireless Sensor Network for Landslide Monitoring System (Suryadi, Prabowo Puranto, Hendra Adinanta, Adrin Tohari, Purnomo S. Priambodo), presented at the 1st International Conference on Physical Instrumentation and Advance Materials, Surabaya, 27 October 2016. Manuscript is accepted for publication on Journal of Physics (Conference Series).

(c) Dissemination :

- Exhibition at National Annual Meeting of Association of Indonesian Disaster Expert (IABI) at Bandung on May 2016.