

Landslide Preparedness in the ASEAN Member States

A Data Fusion Approach to Real-time Monitoring Systems
and Information Management



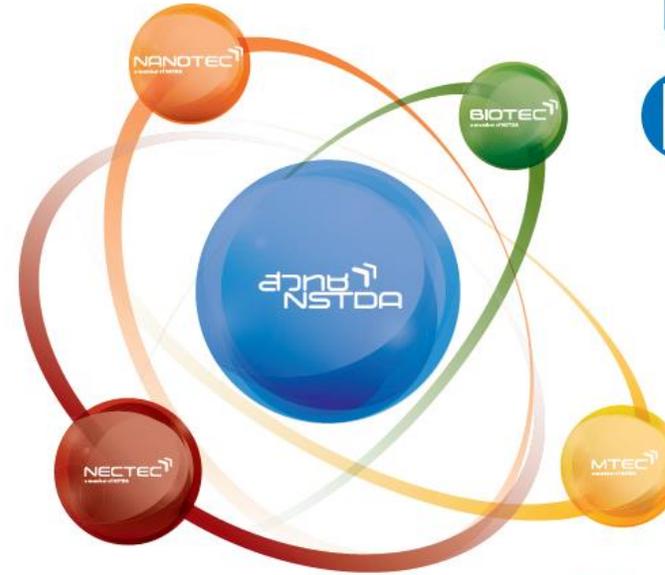
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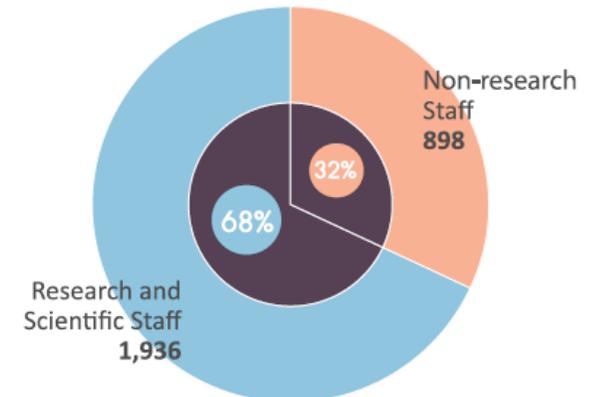
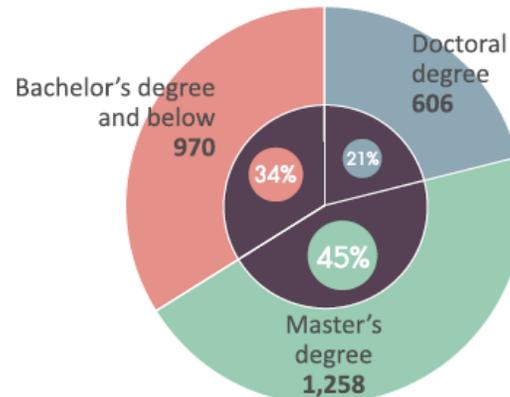
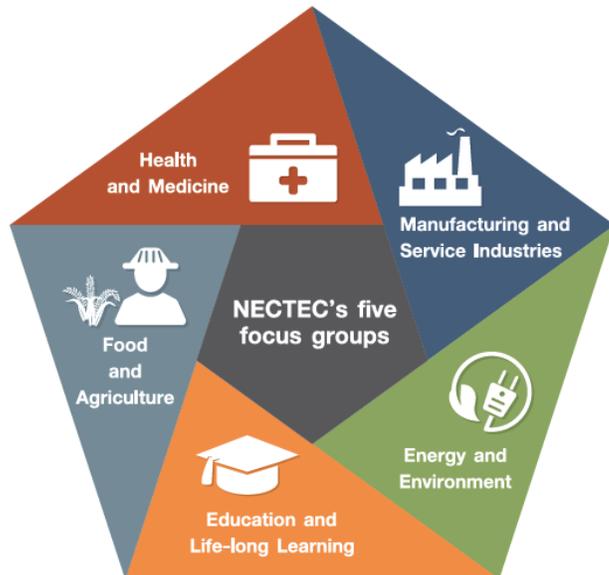
NECTEC-NSTDA

- NECTEC was established by a Cabinet resolution on 16 September 1986 under the MOST.
- Research, development, design and engineering
- Technology transfer to industries and communities
- Human resource development
- Industrial intelligence and knowledge infrastructure



NSTDA Core Values:

- N** Nation First
- S** Science & Technology Excellence
- T** Teamwork
- D** Deliverability
- A** Accountability and Integrity



Landslides are complex and dynamical!

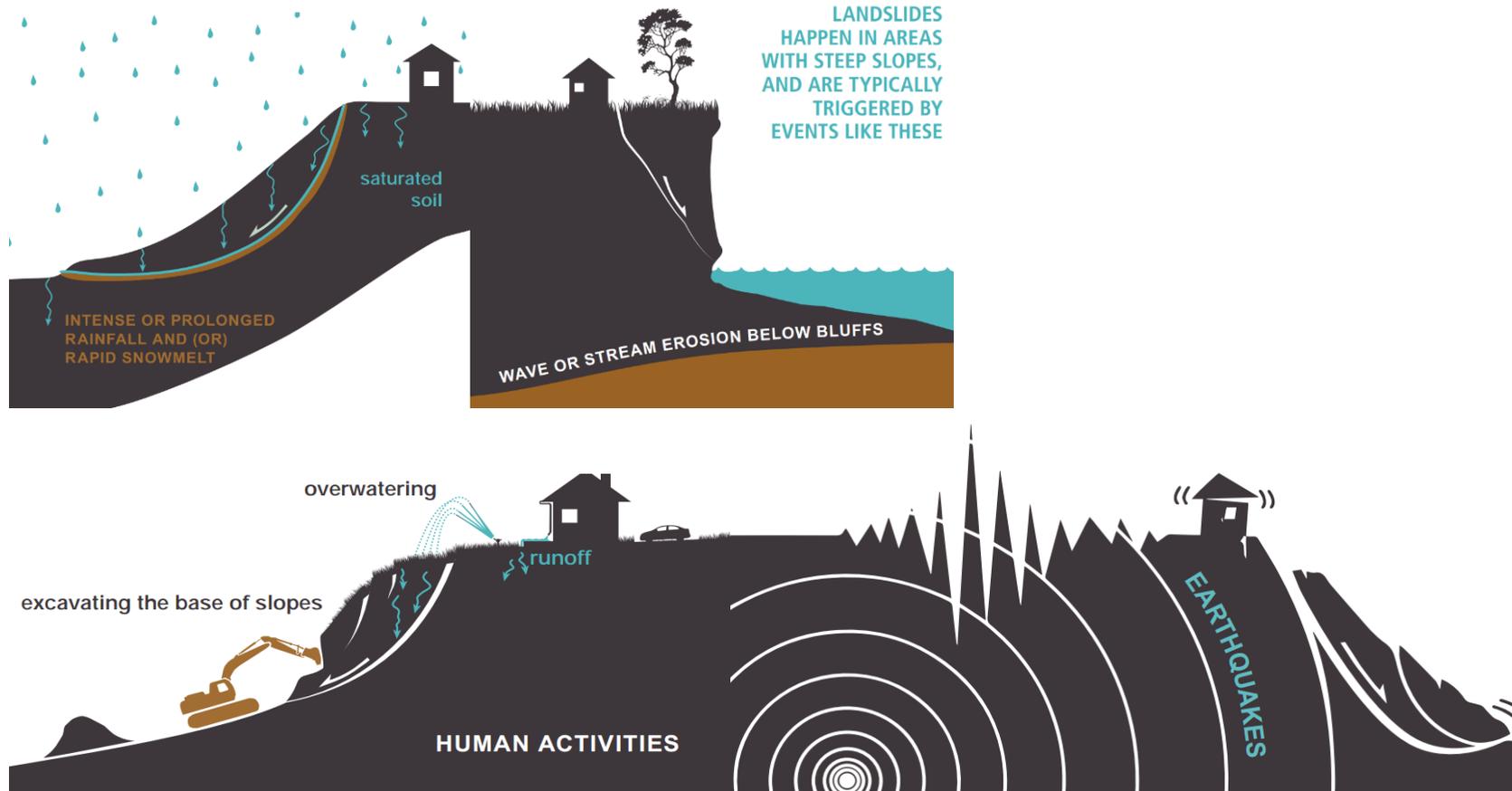


Figure source: A Homeowner's Guide to Landslides for Washington and Oregon, Washington Geological Survey and Oregon Department of Geology and Mineral Industries

Landslides

- Human & Economic losses
- Landslides affect Economy and Ecology.
- Only 3 biggest landslides (1988 – 2006) killed more than 500 people and caused losses more than 1,953 million Baht.



Ban Nam Ko, Phetchabun (Aug 11, 2001)

136 casualties, 109 injures, 4 missing, 188 destroyed houses, and 645 million Baht of total damage



Landslides & SDGs

- **SDG 11:** Make cities and human settlements inclusive, safe, resilient and sustainable
 - **Target 11.5** “By 2030, significantly **reduce** the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product **caused by disasters**, including **water-related disasters**, with a focus on protecting the poor and people in vulnerable situations.”
 - **Indicator 11.5.1:** **Number of deaths**, missing persons and persons affected by disaster per 100,000 people.
 - **Indicator 11.5.2:** Direct disaster **economic loss** in relation to global GDP, including **disaster damage to critical infrastructure** and disruption of basic services.

Landslides & SDGs

- **SDG 13:** Take urgent action to combat [climate change and its impacts](#)
 - **Target 13.1** “Strengthen resilience and adaptive capacity to [climate-related hazards and natural disasters](#) in all countries.”
 - **Indicator 13.1.1:** Number of countries with national and local disaster [risk reduction strategies](#).
 - **Indicator 13.1.2:** [Number of deaths](#), missing persons and persons affected by disaster per 100,000 people.

Climate Change vs Landslide

- Patterns of rainfall and snowmelt, storm intensity and duration, and recharging of soil moisture over the rainy season directly influence landslide incidence.
- High wind can increase loading on trees and play a role in slope failure.

Landslides & SDGs

- **SDG 15:** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Deforestation vs Landslide

Role of Forests & Trees in Landslide Prevention

- Mechanical effects
- Hydrological effects

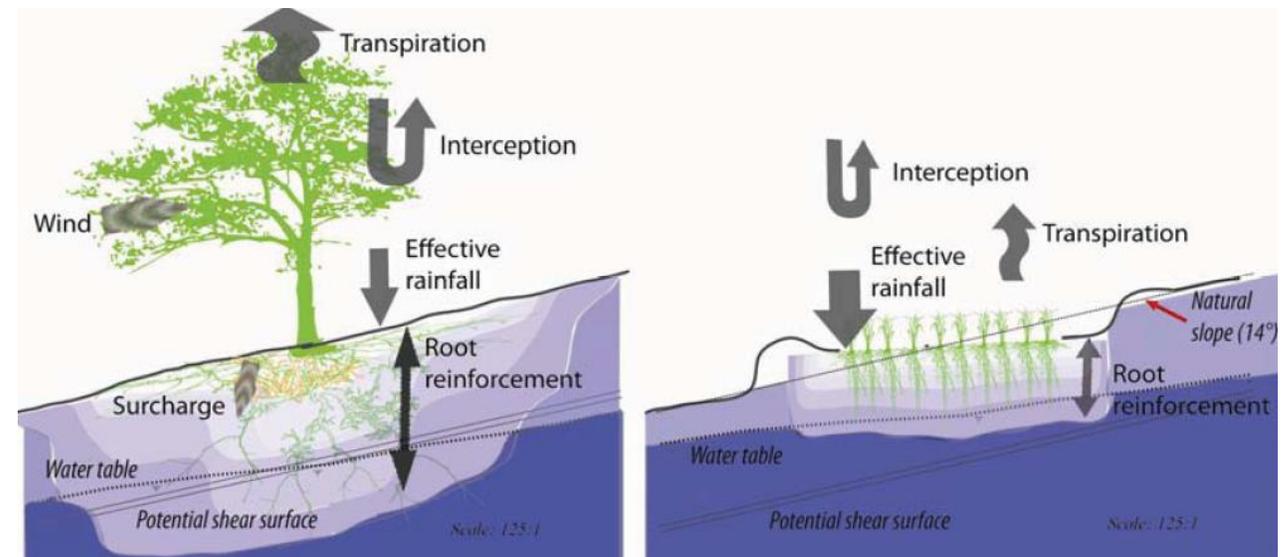
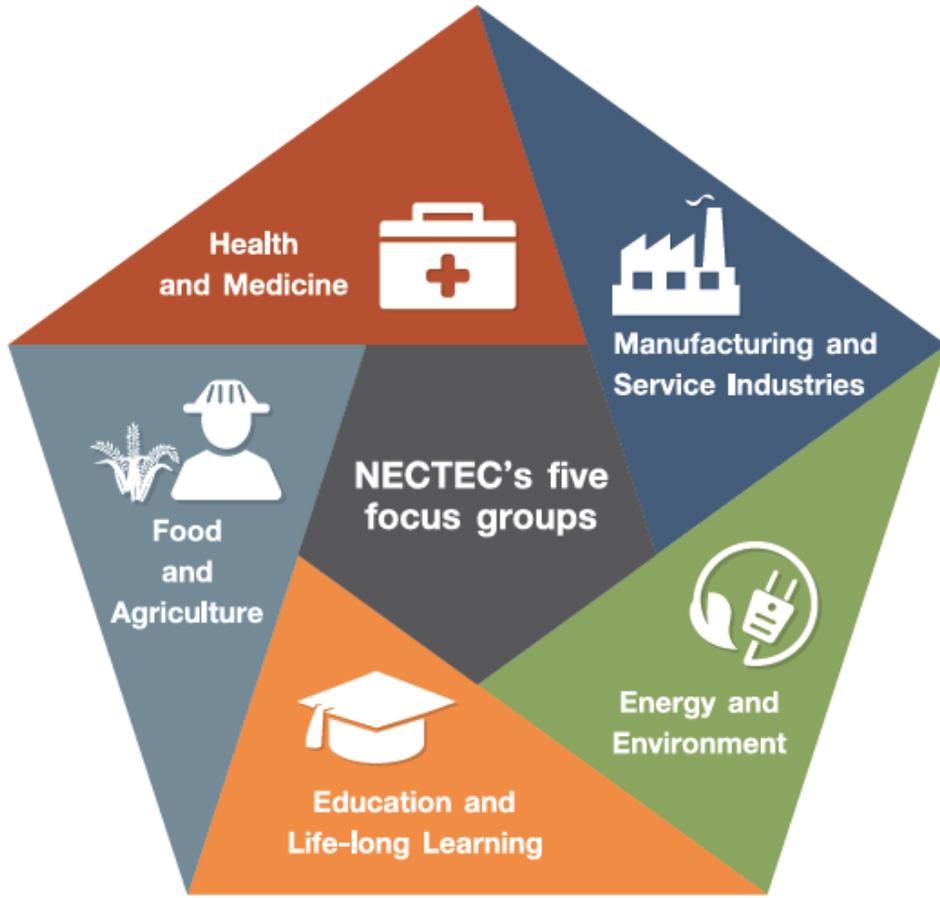


Figure source: Forests and Landslides: The role of trees and forests in the prevention of landslides and rehabilitation of landslide-affected areas in Asia, FAO, UN

EST-NECTEC & Landslide-related Projects



Background

- Weather Station
 - Temperature
 - Humidity
 - Rain
 - Soil Moisture
 - Light
 - Solar Cell + Battery Charger
- Landslide Monitoring System
 - 3 stations in Mae Hong Son
 - 243 stations in Chiang Mai

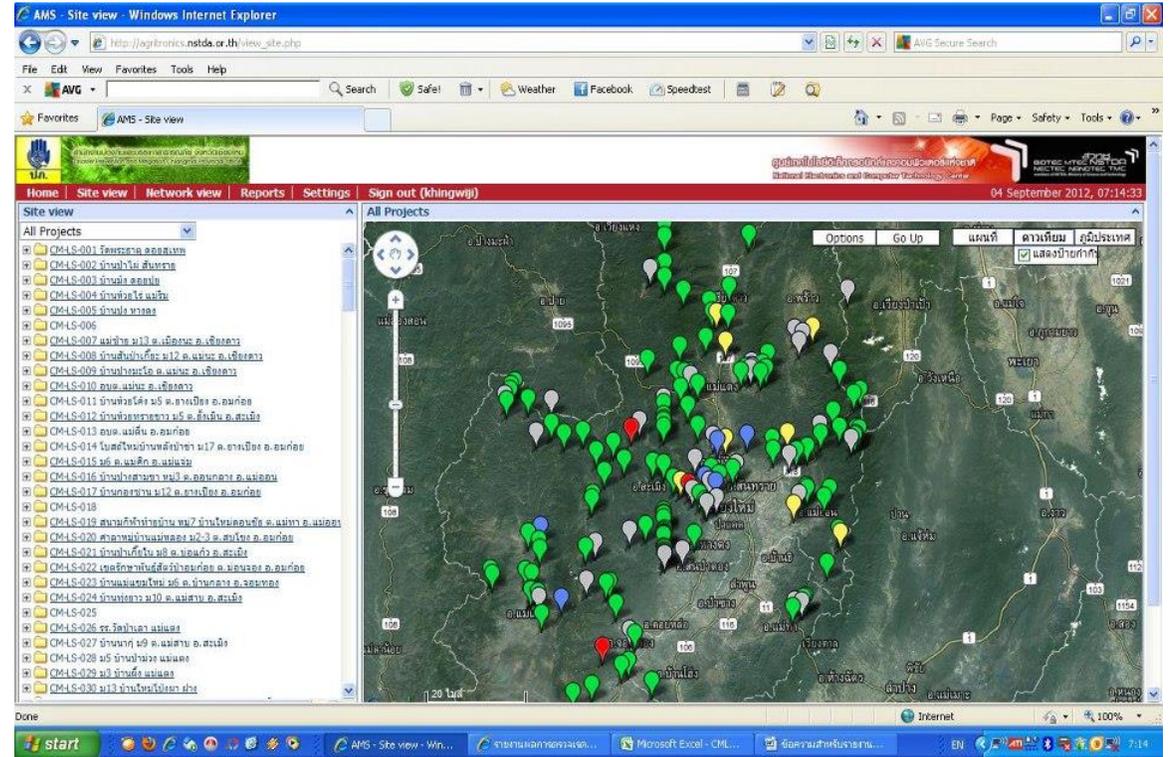


Village/Community



วันที่ Monitoring	
วันที่	12 กันยายน 2551 17:45:00
สถานี	ปภ.
พิกัด	พิกัดพิกัดภูมิศาสตร์ (Lat/Lon) 17.800 101.800
อุณหภูมิ	28.4 °C
ความชื้นสัมพัทธ์	57.5 %
ปริมาณน้ำฝน	0 มม.
ความชื้นดิน	10.8 V
สถานะสถานี	ปกติ

Weather station in Chiang Mai & Locations of currently installed weather stations



International Workshop on Landslide Risk Assessment and Management for the ASEAN Member States



- 1-2 June 2017
- approx. 60 participants
- Lao PDR, Philippines, Vietnam, Singapore, Indonesia, Sri Lanka, Thai Universities and Organizations
- 20 presentations, 4 group discussions

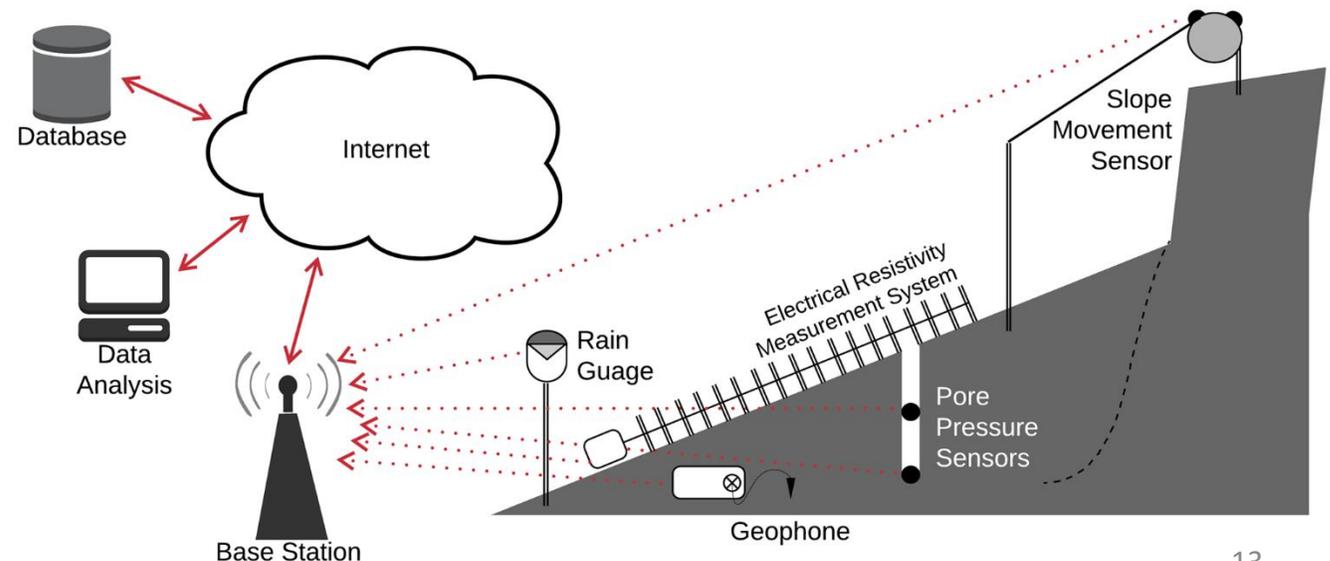


Outputs from the 1st Workshop

- Formed a small research group
- Submitted a few research proposals regarding a real-time monitoring & early-warning system based on WSNs for landslide-prone areas
- Supported (partially) 3 master students
- Organized (partially) the ASEAN NEXT 2018 event

Real-time Monitoring Based on Wireless Sensor Networks for Landslide-Prone Areas

- Supported by the ASEAN Committee on Science and Technology (COST), ASEAN Plan of Action on Science, Technology and Innovation (APASTI) Funding Scheme and the Office of Permanent Secretary of MOST.
- Aims
 - To develop a real-time monitoring system based on WSNs for landslide prone areas in ASEAN
 - To investigate environmental parameters and conditions of potential landslides
 - To promote sharing the monitoring data
- Partners: PHILVOCS, TCEI, MU, SIIT, TU
AIT, RMUTT, DDMP, DMR, NICT



What are challenges in terms of WSN?

- It needs to cope with noisy sensor data. Hence, signal smoothing techniques are required.
- It should handle any network fault, for example, a failure due to transmission link.
- It should address the problem of unequal energy depletion in the system.
- It should balance two functions, which are rare event detection and periodic data collection.

ASEAN NEXT 2018: Landslide Preparedness in the ASEAN Member States: A Data Fusion Approach to Real-time Monitoring Systems and Information Management

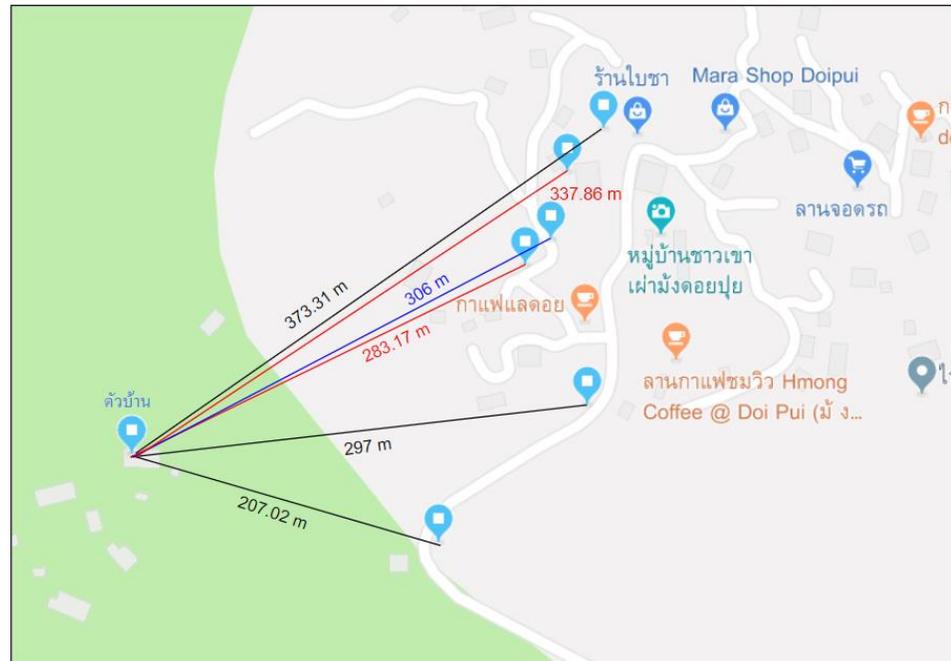
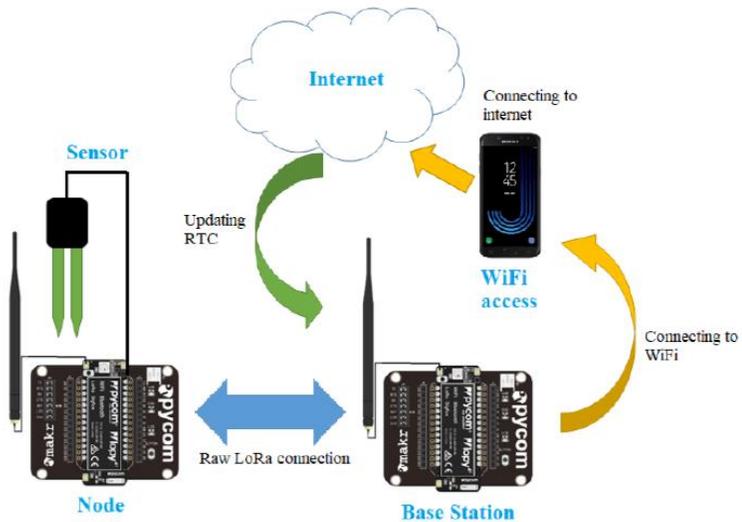
- 21-22 March 2018
- Venue: Bangkok and landslide-prone areas in Chiang Mai
- Partners: **Philippines** (PHIVOLCS), **Lao PDR** (TCEI), **Vietnam** (Thuloi U., IOIT), **Indonesia** (LIPI), **Malaysia** (UTM), **Myanmar** (UCSY), **Cambodia** (e-Gov), **Brunei Darussalam** (UTB), **Japan** (NICT, Gunma U.), **Taiwan** (NCHC), **Thailand** (SIIT, TU, MU, RMUTT, AIT, DMR, DDPM, CCOP, etc.)
- Event Purpose
 - To share view points and ideas regarding technical issues to improve landslide monitoring systems.
 - To discuss a joint research project on real-time monitoring system based on WSNs.
 - To visit landslide prone areas in order to discuss possibilities of implementing a practical system.
- Contribution to ASEAN
 - Awareness of the current state of knowledge and situations, which can pave the way to improvement in landslide risk assessment and management.
 - Research collaboration toward a real-time monitoring system based on WSNs for landslide-prone areas.

Activities in the ASEAN NEXT 2018

- Field trip/survey
- Presentations
- Brainstorming



Designing & Testing: Soil Resistivity Meter, LoRa

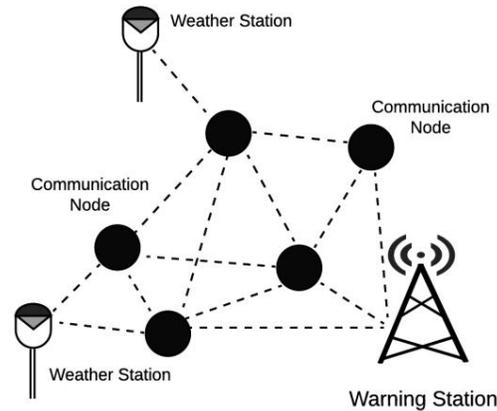


NICT's Visual IoT



Other Projects

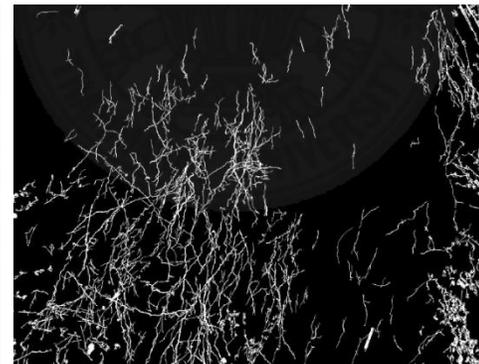
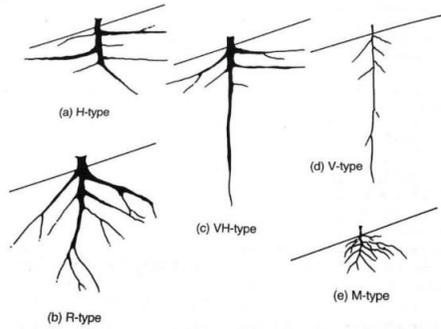
- A nerve network platform for sensors and actuators in rural and mountainous areas
 - Early-warning system
 - NICT (Japan) and DDPM (Thailand)



- Implementation of Mesh-topological, Low-power Wide Area (MLWA) Communication Networks for Disaster Monitoring in Prone-areas of Thailand
 - Early-warning system
 - NICT, EGAT, and DDPM

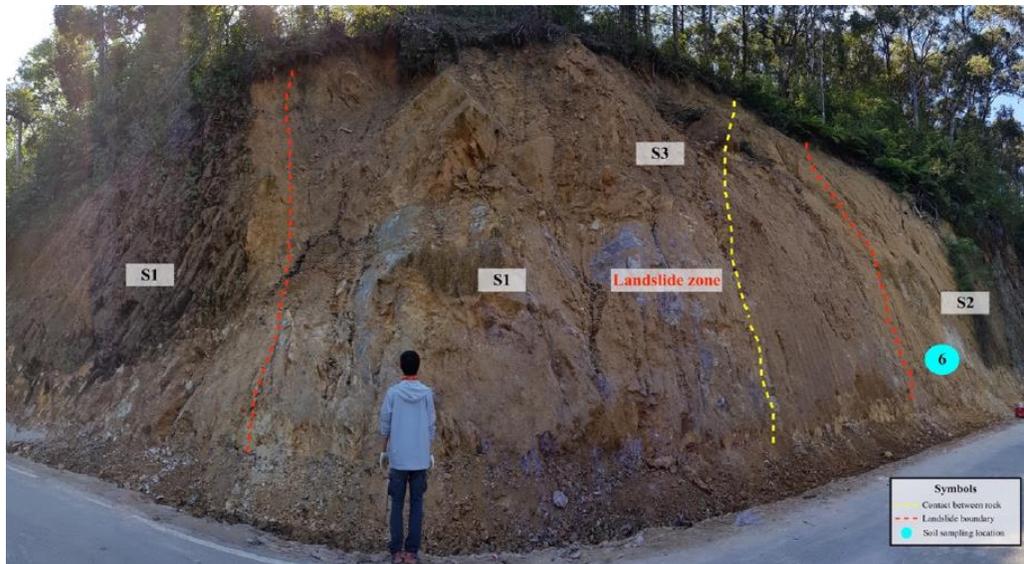
Other Projects

- The Study of the Effects of Vegetation on Slope Stabilization for Landslide Prevention in Thailand (Ms. Katekanya Tadsuwan, Assoc. Prof. Dr. Alice Sharp, & Dr. Jessada Karnjana, SIIT + NECTEC)



Other Projects

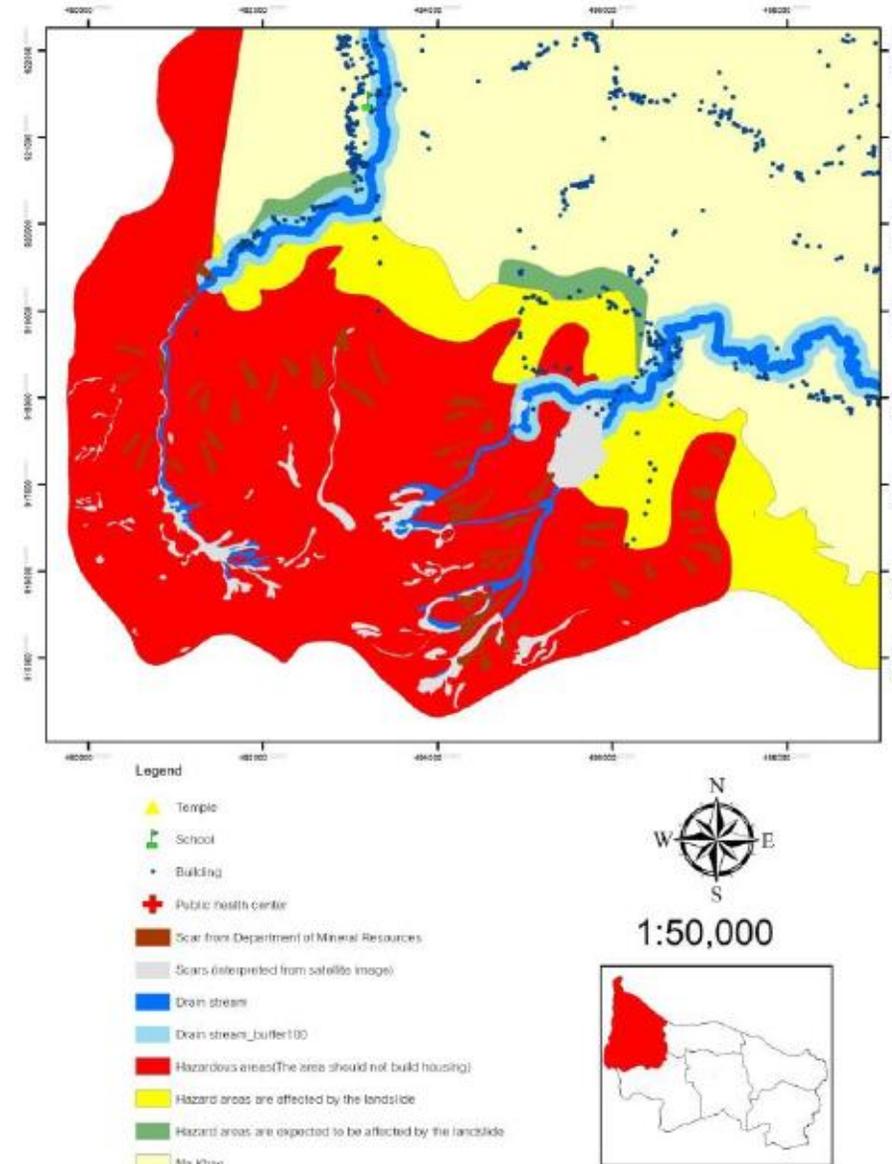
- Landslide Investigation in View of Geology and Slope Stability: A Case Study of Highway 1390, Doi Tung, Chiang Rai, Thailand (Ms. Sasima Yoochareon, Assoc. Prof. Dr. Suttisak Soralump, Assoc. Prof. Dr. Alice Sharp, & Dr. Jessada Karnjana, KU + SIIT + NECTEC)



Other Projects

- Assessment of Landslide Susceptibility Area Using RS and GIS (Ms. Preechaya Kittipakawat & Assoc. Prof. Dr. Suttisak Soralump, Assoc. Prof. Dr. Alice Sharp, & Dr. Jessada Karnjana, KU + SIIT + NECTEC)

Landslide Hazard Area of Na Khao





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