Landslide Preparedness in the ASEAN Member States

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

Jessada Karnjana, PhD
National Electronics and Computer Technology Center
2018.03.20

Landslides are complex and dynamical!

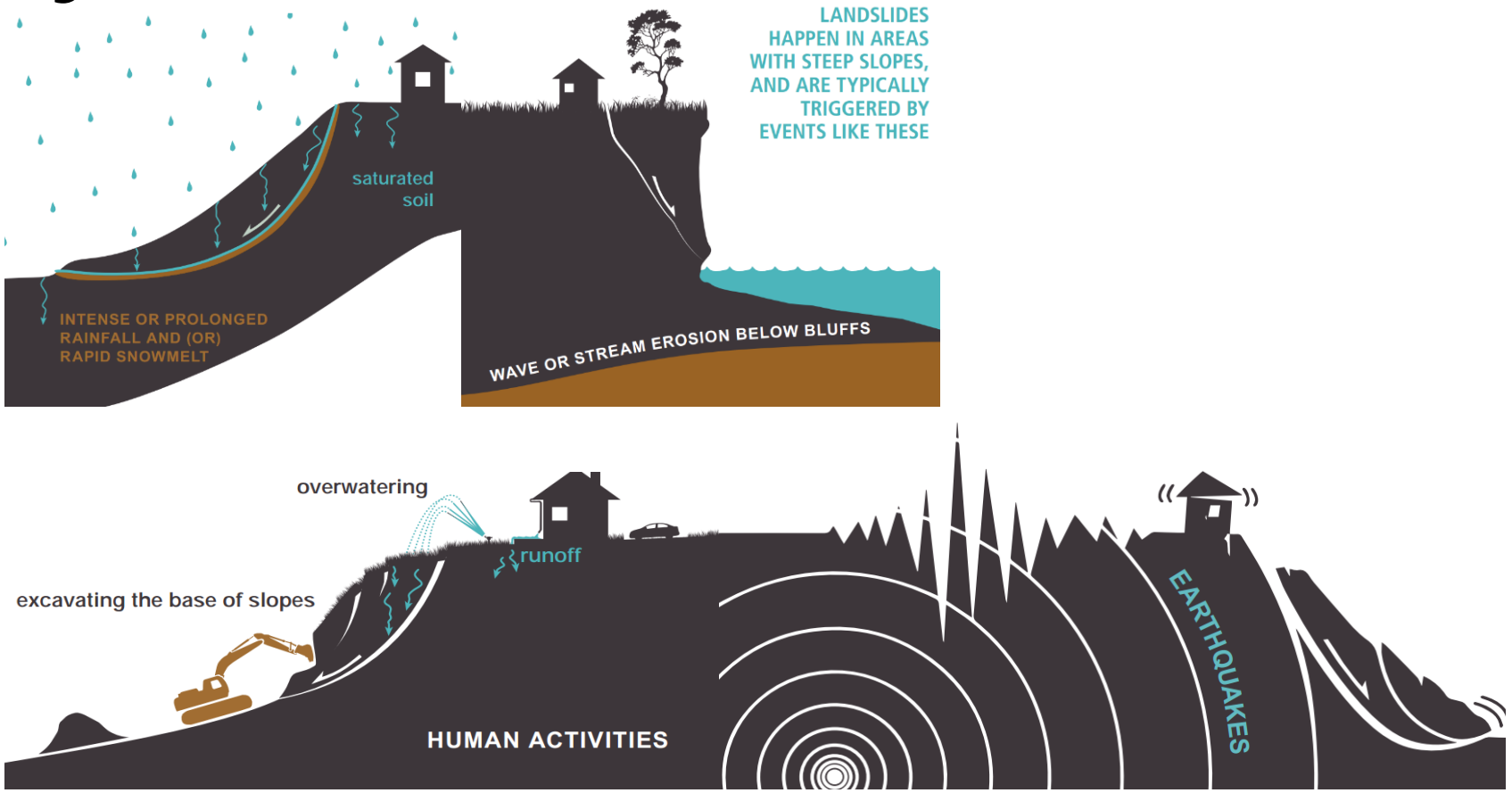


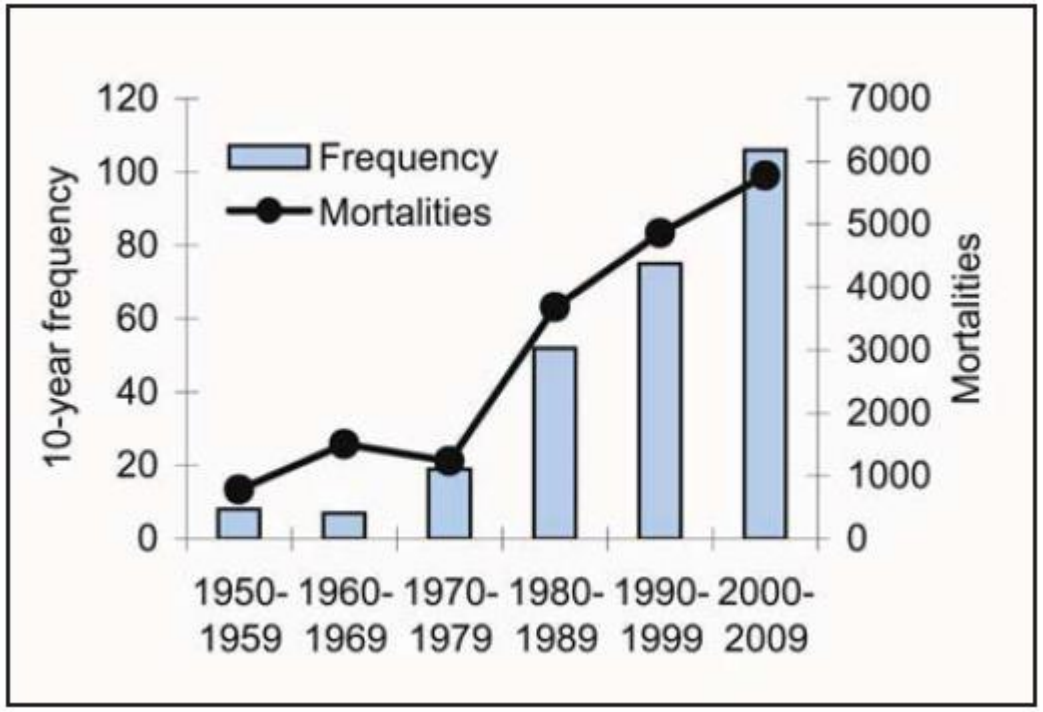
Figure source: A Homeowner's Guide to Landslides for Washington and Oregon, Washington Geological Survey and Oregon D

Landslides

- Human & Economic losses
- Landslides affect Economy and Ecology.
- Only 3 biggest landslides (1988 – 2006) have 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

Landslide Trends in Asia



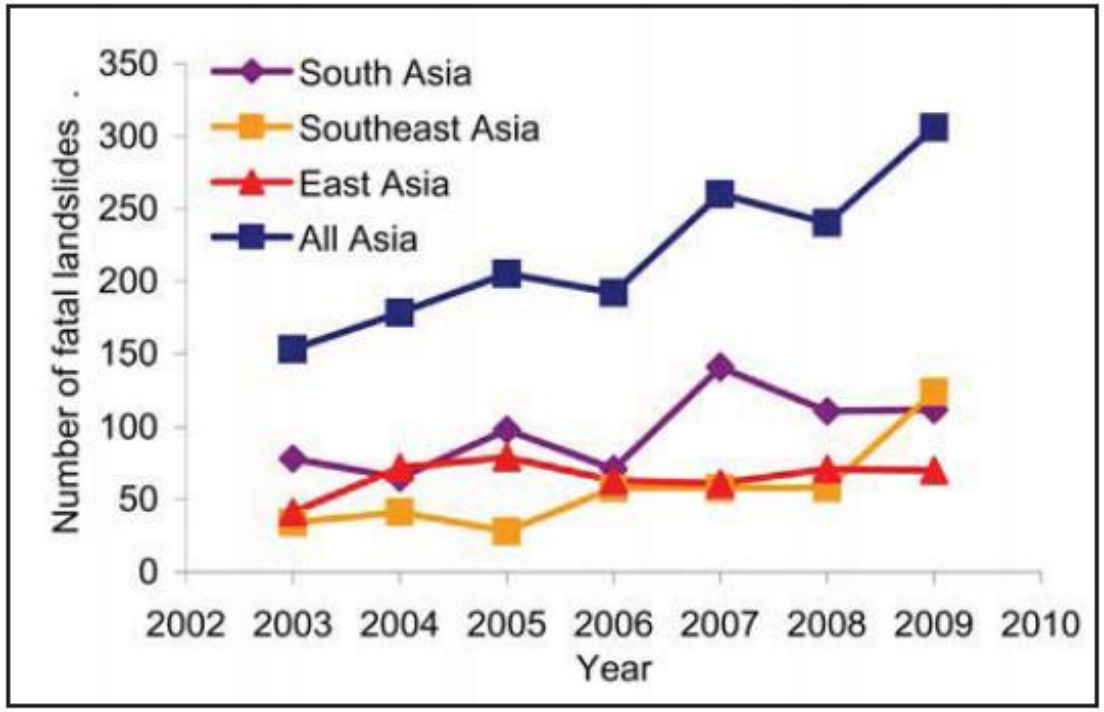


Figure source: Forests and Landslides: The role of trees and forests in the prevention of landslides and rehabilitation of lanc

Landslide & SDG

- **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.

Landslide & SDG

- **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.

Landslide & SDG

- **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

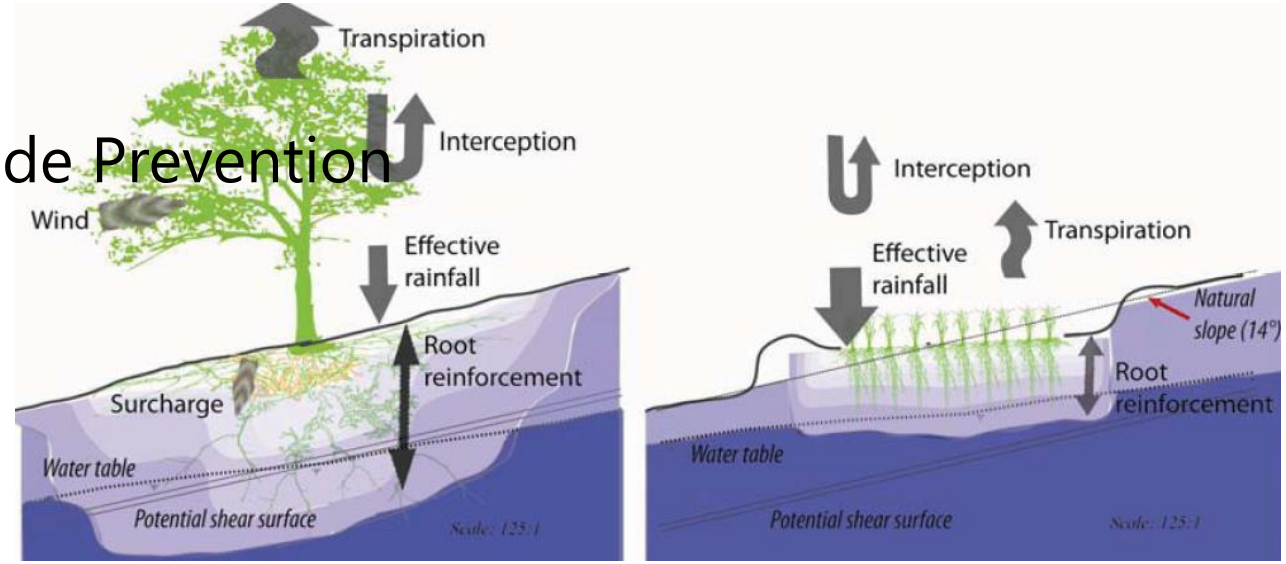


Figure source: Forests and Landslides: The role of trees and forests in the prevention of landslides and rehabilitation of lar

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.

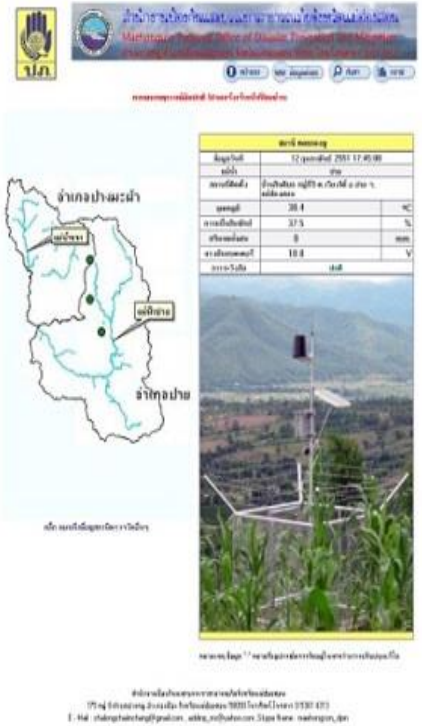
International Workshop on Landslide Risk Assessment and Management for the ASEAN Member States

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

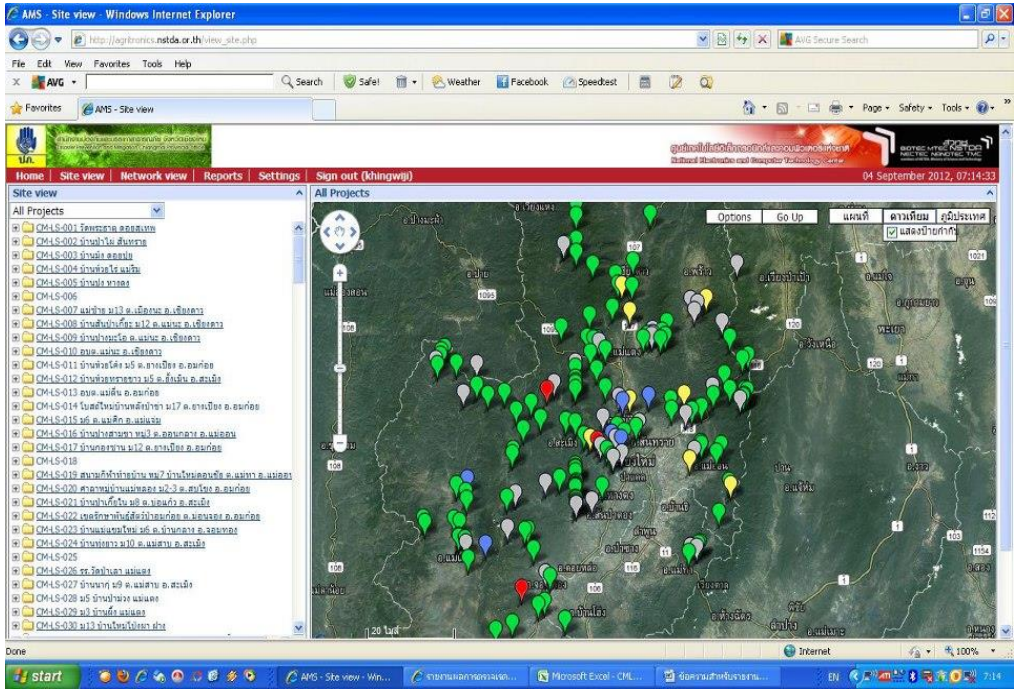
Background

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

Village/Community



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

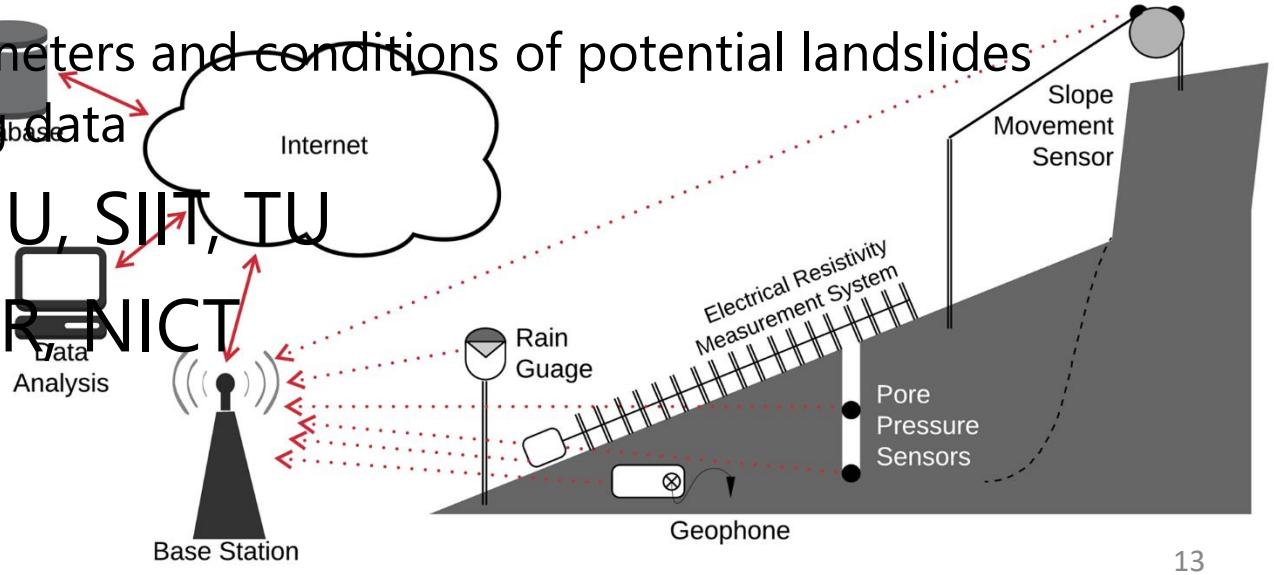


Outputs from the 1st Workshop

- 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) two master students
- Organized (partially) this event

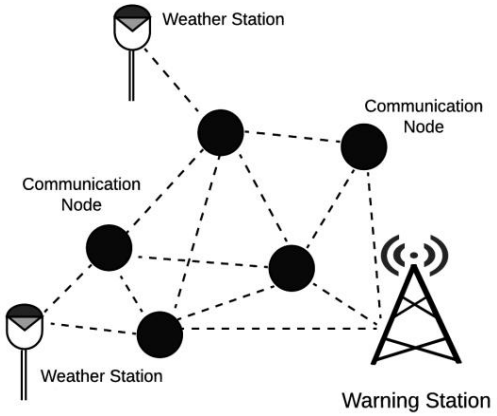
Real-time Monitoring Based on Wireless Sensor Networks for Landslide-Prone Areas

- 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



Other Projects

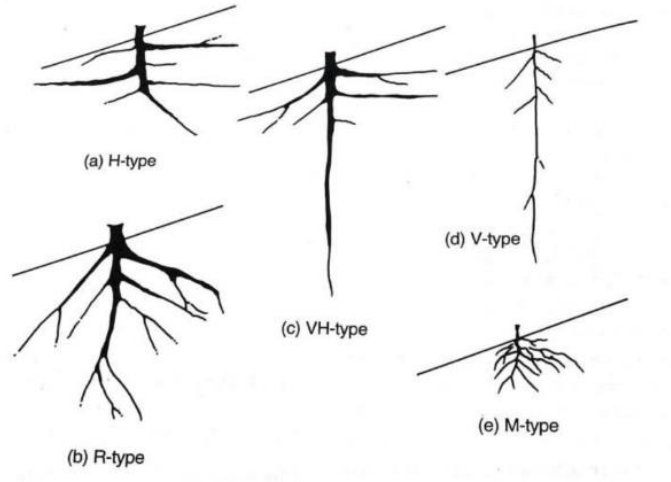
- A nerve network platform for sensors and actuators in rural and mountainous areas
  - Early-warning system
  - NICT (Japan) and DDPM



- Establishment of a Landslide Monitoring and Prediction System
  - Data analytics, Mathematical modeling, Developing a method for landslide susceptibility mapping
  - Gunma University (Japan), Teikyo Heisei University (Japan), Thuloi University (Vietnam), Mahidol University (Thailand), SIIT (Thailand), Thammasat University (Thailand), DMR (Thailand), and DDPM (Thailand)

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**, SIIT)



- 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**, KU & SIIT)

Other Purposes of this Workshop

In addition to the purposes mentioned on page 7, this workshop has other 2 purposes.

- To kick off a meeting for the projects supported by ASEAN COST & MOST.
- To find new friends.

NECTEC

a member of NSTDA