



**BỘ TÀI NGUYÊN VÀ MÔI TRƯỜNG**  
**VIỆN KHOA HỌC ĐỊA CHẤT VÀ KHOÁNG SẢN**  
VIETNAM INSTITUTE OF GEOSCIENCES AND MINERAL RESOURCES



# Investigation, assessment and warning zonation for landslides in the mountainous regions of Vietnam

*(State-Funded Landslide Project – SFLP)*

*Dr. Eng. Le Quoc Hung*



**Add:** 67 Chien Thang Street, Ha Dong District,  
Hanoi City, Vietnam

**Phone :** (++84) 4 3854 4386

**Fax:** (++84) 4 3854 2125

**Email:** [vigmr@vigmr.vn](mailto:vigmr@vigmr.vn)

**Website:** <http://www.vigmr.vn>





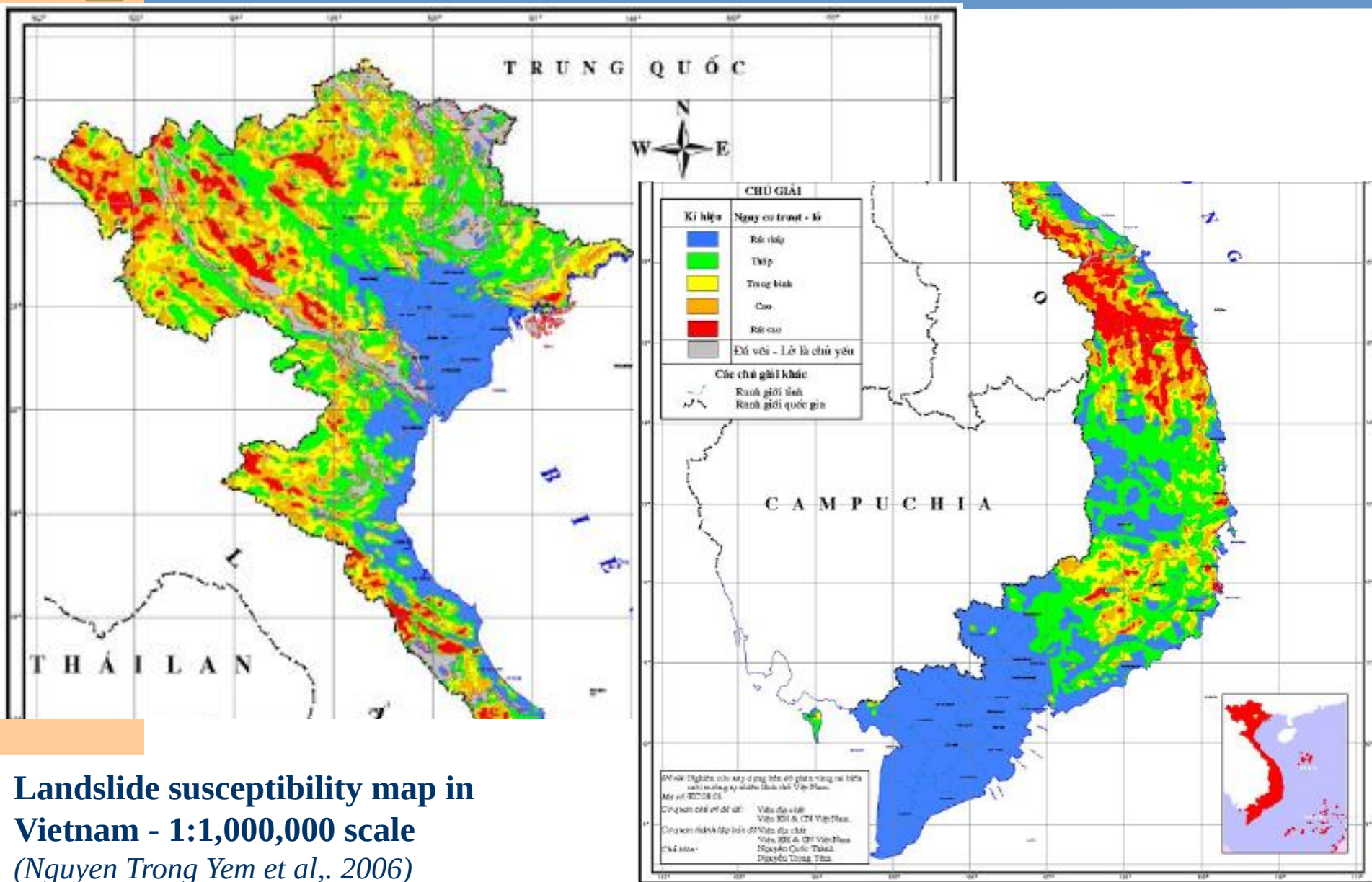
# Contents



1. Landslides in Vietnam
2. State-Funded Landslide Project (SFLP)
3. Results of SFLP so far
4. Challenges for SFLP and lessons learned
5. The next plans of SFLP



# LANDSLIDES IN VIET NAM



**Landslide susceptibility map in Vietnam - 1:1,000,000 scale**  
(*Nguyen Trong Yem et al., 2006*)



# LANDSLIDE IN VIET NAM: Causes

- ❖ Vietnam = one of the countries affected by global climate change
  - Abnormal weather events ➔ **extreme rainfall**
- ❖ Mountainous regions in Vietnam:
  - ✓ Prone to geo-hazards
  - ✓ Potential of mineral resources, hydroelectricity, tourism etc.
  - ✓ Play an important roles in national socio-economic
  - ✓ Attract human resources
- ❖ Rapid development and urbanization in mountains
  - Human activities ➔ **negative impacts** (*deforestation, mining, slope-cuts for construction, etc.*).
    - ➔ significantly promoting geohazard process
      - ➔ *triggering landslides in residential areas, road corridors, hydroelectricity's reservoir, mining areas...*
      - ➔ *increasing loss of lives and damages to people, infrastructure and environment.*





# LANDSLIDE IN VIET NAM: Consequences



**Tuyên Hóa – Quảng Bình**



**Minh Hóa – Quảng Bình**



**Minh Long-Quảng Ngãi**



**Minh Long – Quảng Ngãi**



**Minh Long –Quảng Ngãi**



**Minh Hóa – Quảng Bình**

VIGMR



# LANDSLIDE IN VIET NAM: Consequences



## Landslides in Lao Cai province







# LANDSLIDE IN VIET NAM: Consequences



**Landslides in Dien  
Bien province**



# STATE-FUNDED LANDSLIDE PROJECT (SFLP)



- **Titled:** *Investigation, assessment and warning zonation for landslides in the mountainous regions of Vietnam*
- **So-called:** *State-Funded Landslide Project (SFLP)*
- **Approved under:**
  - *the Decision Nr. 351/QĐ-TTg on 27 March 2012 by the Prime Minister of the Socialist Republic of Vietnam*
  - *the Decision Nr. 1409/QĐ-BTNMT on 29 August 2012 by the Minister of Natural Resources and Environment (MONRE)*
- **Launched:** *October 2012*
- **Planned to execute:** *2012-2020*
  - *Phase I: 2012-2016*
  - *Phase II: 2017-2020*





# STATE-FUNDED LANDSLIDE PROJECT (SFLP)



## ❖ Carried out by:

- *15 research institutions and all administrative divisions under MONRE*
- *Vietnam Institute of Geosciences and Mineral Resources (VIGMR) = leading institute*

## ❖ Implemented in *all mountainous areas*

- *75% area of the country territory*
- *37/63 provinces*

VIGMR



# PROJECT AIMS



- **Establishment of a standard national database on landslides and generation of landslide hazard maps at scales of 1:50,000 and 1:10,000 for specific areas in 37 mountainous provinces of Vietnam;**
- **Design of an Early Warning System for landslides, and implementing that in a number of test areas.**

VIGMR



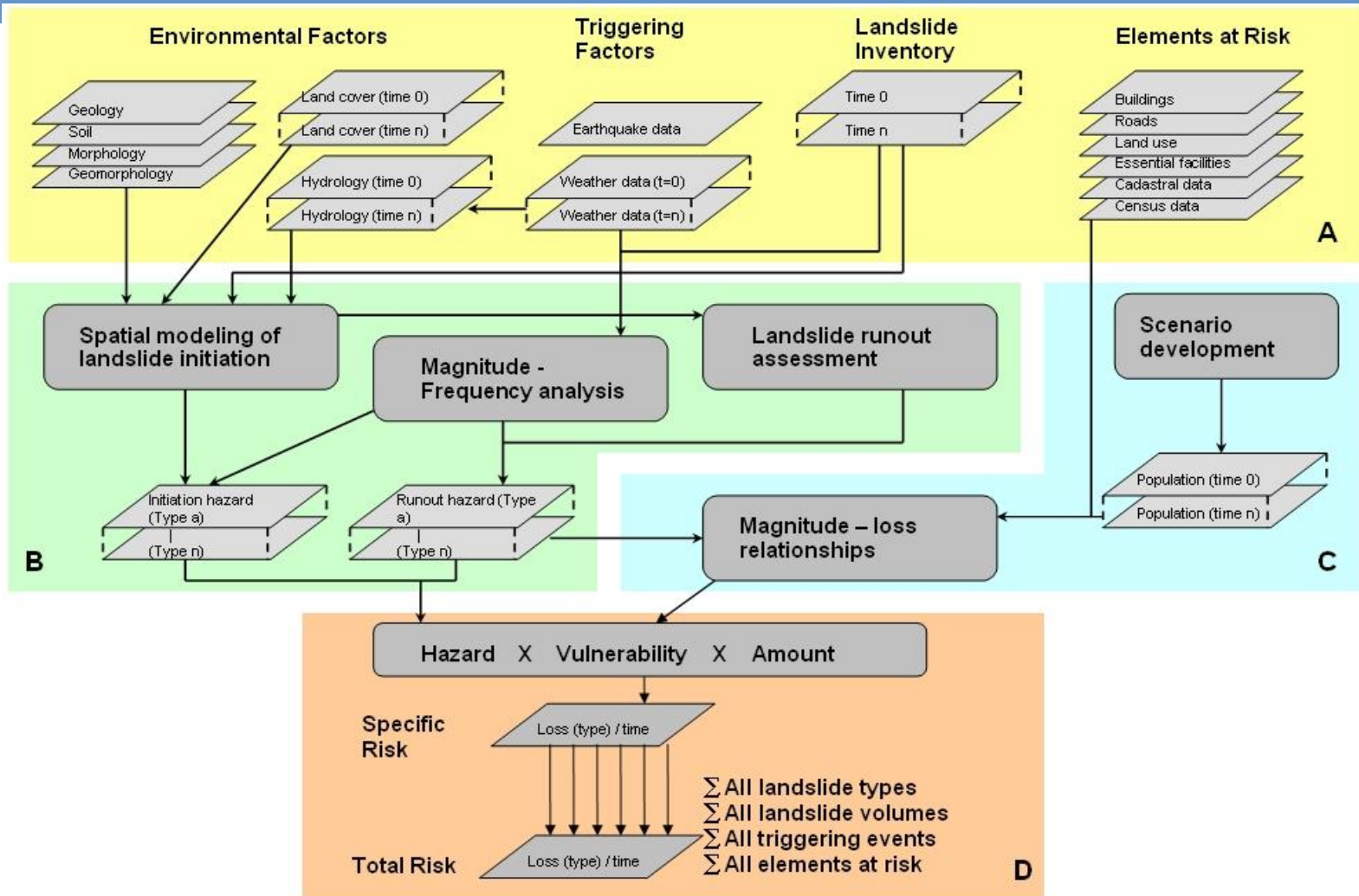


# PROJECT MAIN TASKS

1. Collecting, analyzing and compiling all data and documentation related to landslide hazard and risk;
2. Landslide inventory mapping, assessment of landslide causes and consequences, zoning of landslide susceptibility, hazard and risk for all mountainous regions of Vietnam;
3. Establishing a set of atlas of landslide warning zonation maps at scales of 1:50,000 for 37 mountainous provinces and at scales of 1:25,000 to 1:10,000 for high landslide hazard risk areas;
4. Establishing a scientific relevance for the setup of a landslide monitoring and early warning network in mountainous areas;
5. Pilot instrumentation for landslide monitoring at some landslide hotspots;
6. Developing a set of guidelines for the use of landslide databases, landslide hazard risk zonation maps, and landslide monitoring network;
7. Transferring of the Project results to the end-users to improve their capacity of landslides mitigation and management.



# PROJECT WORKFLOW



**A: Data collection and establishment of factor maps**

**B: Susceptibility and hazard modeling component**

**C: Vulnerability assessment component**

**D: Risk assessment component**

(adapted from Castellanos Abella, E.A., de Jong, S.M., Van Westen, C.J. and van Asch, W.J., 2008. Multi-scale landslide risk assessment in Cuba. ITC, University of Utrecht. ITC Dissertation 154, 272 p. ISBN: 978-90-6164-268- 8)



# PROJECT DELIVERABLES



- 1. A national database and WebGIS on landslides and related factors;**
- 2. Landslide warning zonation maps at 1:50,000 scales for 37 mountainous provinces, and at 1:10,000 scales for hotspots areas:**
  - *Landslide inventory maps*
  - *Landslide susceptibility maps*
  - *Landslide hazard maps*
  - *Landslide risk maps*
- 3. A pilot network of landslide monitoring stations**
- 4. Reports and guidelines to end-users for:**
  - *Using the result maps, WebGIS and database*
  - *Recommendation of landslide mitigation measures;*
  - *Dissemination and communication of landslide preparedness, prevention and mitigation;*
  - *Proposed network of landslide monitoring and early warning for very high landslide hazard areas.*

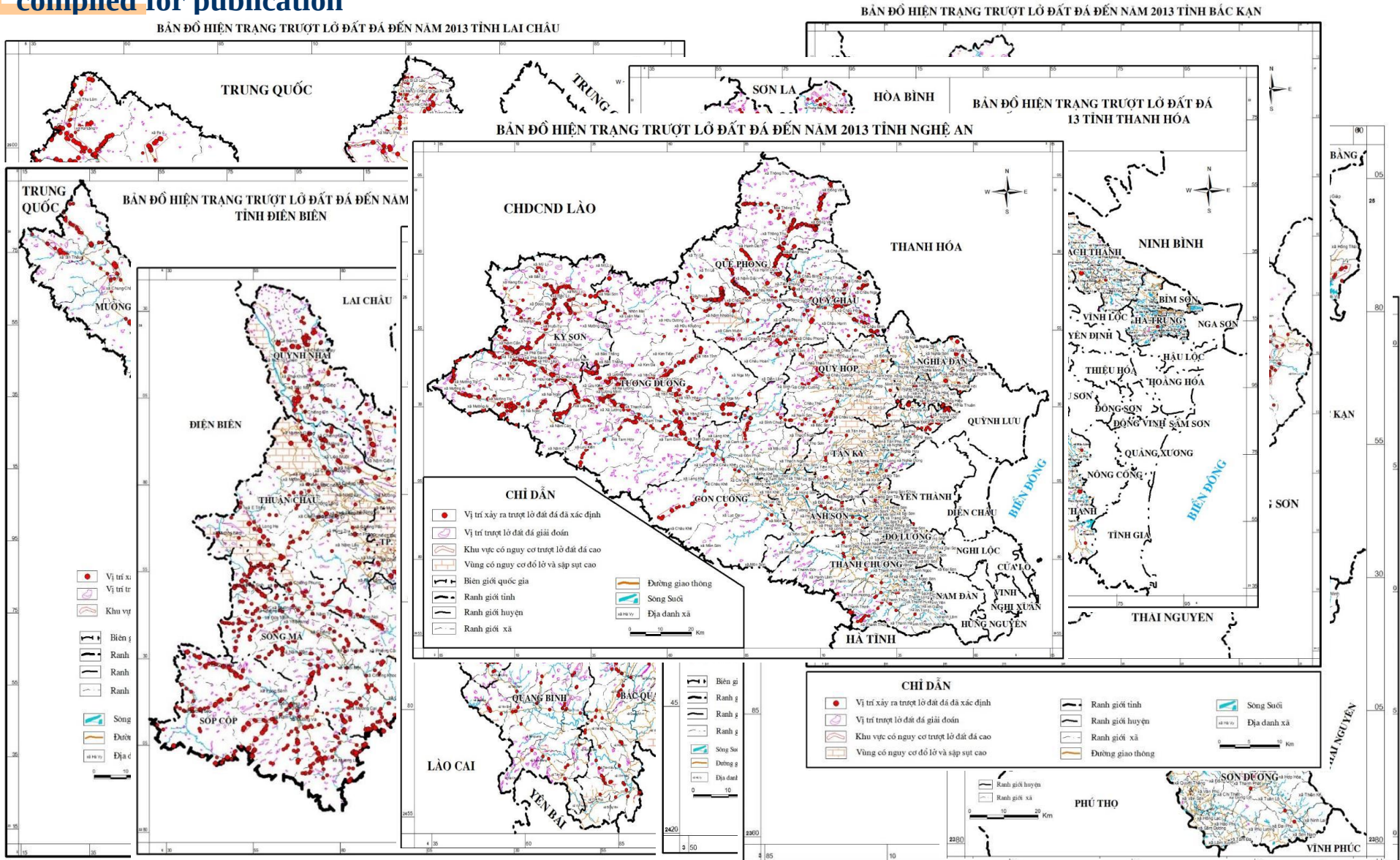




# PROJECT RESULT SO FAR (10/2012-12/2014)



**Landslide inventory maps at 1:200,000 scales for 14 Northern mountainous provinces that are compiled for publication**

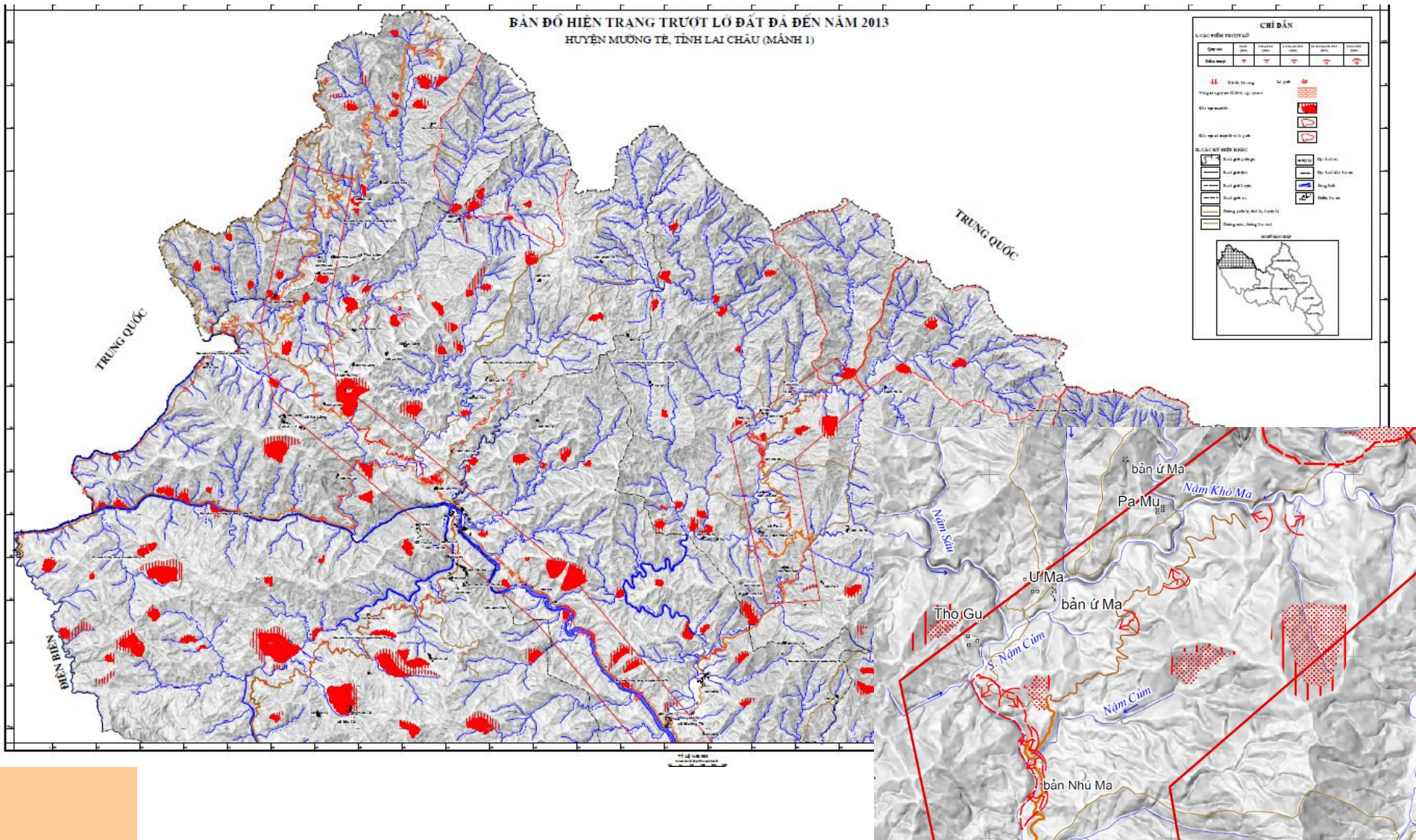




# PROJECT RESULT SO FAR (10/2012-12/2014)



## Landslide inventory maps at 1:50,000 scales for 14 Northern mountainous provinces that are handed over to regional and local authorities









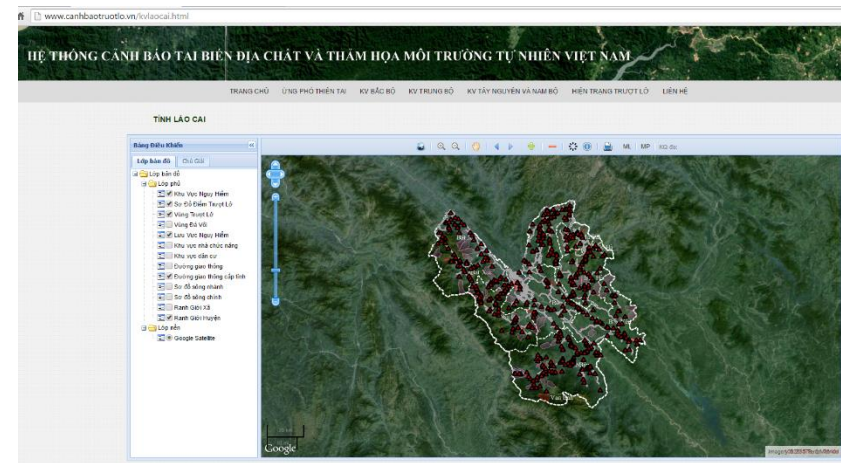
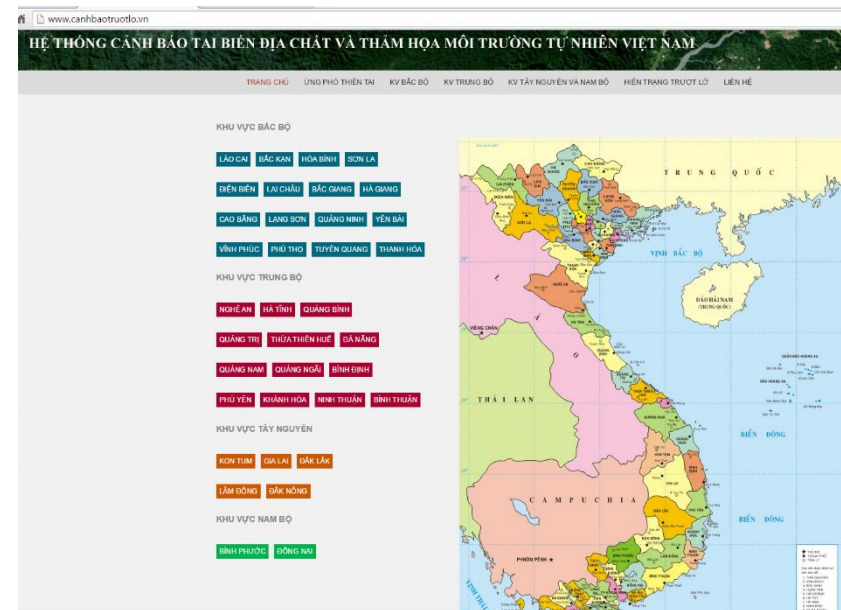
# PROJECT RESULT SO FAR (10/2012-12/2014)



## Handover of the 1:50,000 landslide inventory maps to provincial leaders



## Publishing a WebGIS on landslide in Vietnam at [www.canhbaotruotlo.vn](http://www.canhbaotruotlo.vn)





# CHALLENGES

## 1. Input data



➤ Input data collected from different sources:

- ✓ Low quality
- ✓ Inaccuracy / overlapping / irrelevant attributes
- ✓ Not up-to-date (land cover, land use...)
- ✓ Incomplete relevant data (landslide factor maps) for landslide susceptibility, hazard and risk mapping

| Group              | Factor                           | Collected data                |                                    |
|--------------------|----------------------------------|-------------------------------|------------------------------------|
|                    |                                  | Available                     | Quality of data                    |
| Drainage factors   | Eroding sections of mains rivers | Used                          | Moderate                           |
|                    | Closeness to eroding streams     | Used                          | Moderate                           |
|                    | Distance from stream initiation  | Not used                      | -                                  |
| Geological factors | Lithological map                 | Used                          | Poor quality, location and content |
|                    | Soil type map                    | Not available                 | -                                  |
|                    | Fault map                        | Available but not used        | Poor quality, needs revision       |
| Land cover factors | Land cover existing              | Not available                 | -                                  |
|                    | Land cover (10 years old)        | Used                          | Very poor quality information      |
|                    | Land cover changes               | Not available                 | -                                  |
|                    | Road cuts                        | Used                          | Moderate                           |
|                    | Cuts for building construction   | Not available                 | -                                  |
| Triggering factors | Spatial distribution of rainfall | Not available                 | -                                  |
|                    | Peak ground acceleration         | Not available                 | -                                  |
| Landslides         | Old landslides                   | Not available, partially made | Low quality                        |
|                    | Historic landslides              | Used                          | Limited to roads                   |





# CHALLENGES AND LESSON LEARNED

## 2. Scientific opinions

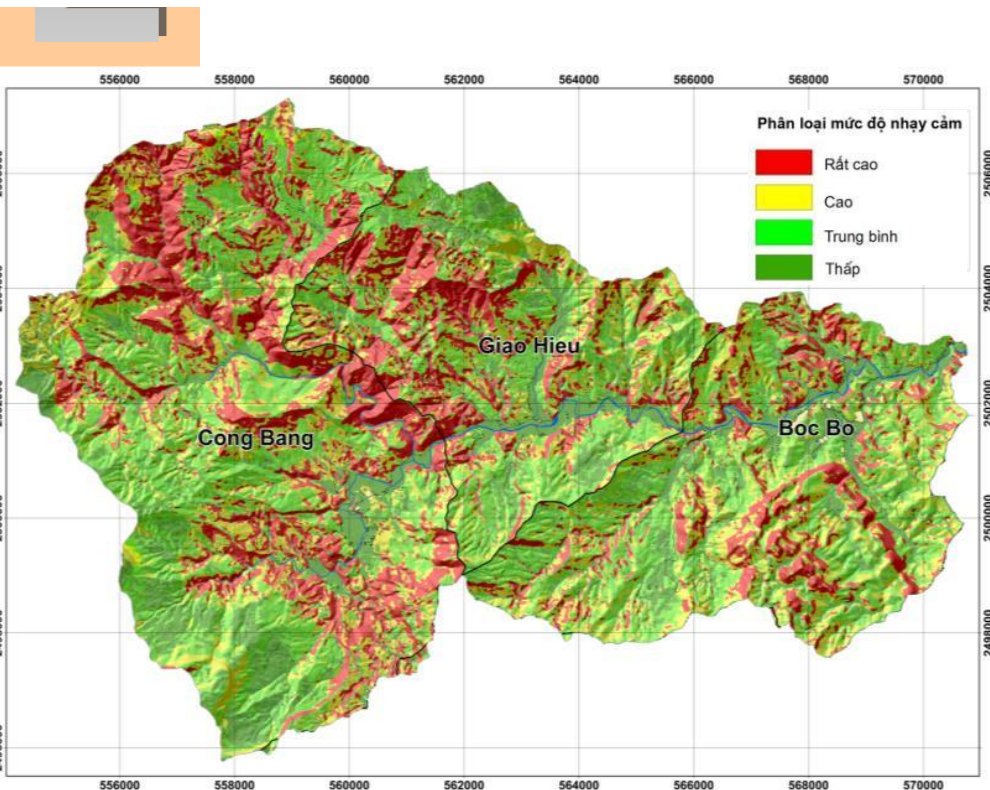


### ➤ Controversy about implementing procedures:

- ✓ Mapping for all mountainous areas from medium scale to large scale (1:50.000 → 1:10.000 → site investigation of hotspots) *for land use planning including measures of landslide hazard mitigation and risk reduction*

OR:

- ✓ Detail investigation of selected hotspots *for monitoring & warning of landslides*







# CHALLENGES AND LESSON LEARNED

## 3. Community contributions



- Different understandings of local and regional authorities about:
  - ✓ *use of landslide susceptibility, hazard and risk maps;*
  - ✓ *Their roles if helping scientists in landslide investigation and field surveys*
- ➔ *Need a lot of effort to persuade local leaders and people to agree/compromise with and give their contribution to the Project*



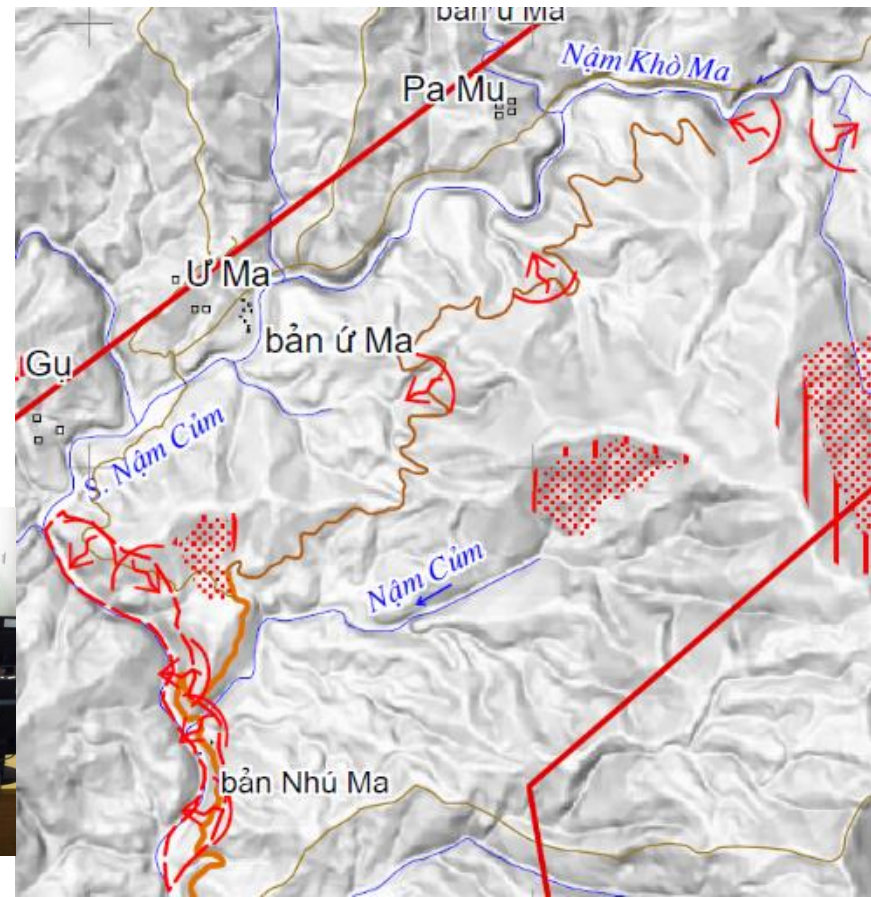


# CHALLENGES AND LESSON LEARNED



## 4. Capacity of Project staffs

- Not not so familiar with the use of image interpretation
- Lack of skills and experience of the field surveyors for landslide inventory:
  - *A lot of landslides were found and investigated mainly along the road cuts*
  - *Large amount of data fields have incomplete landslide records*





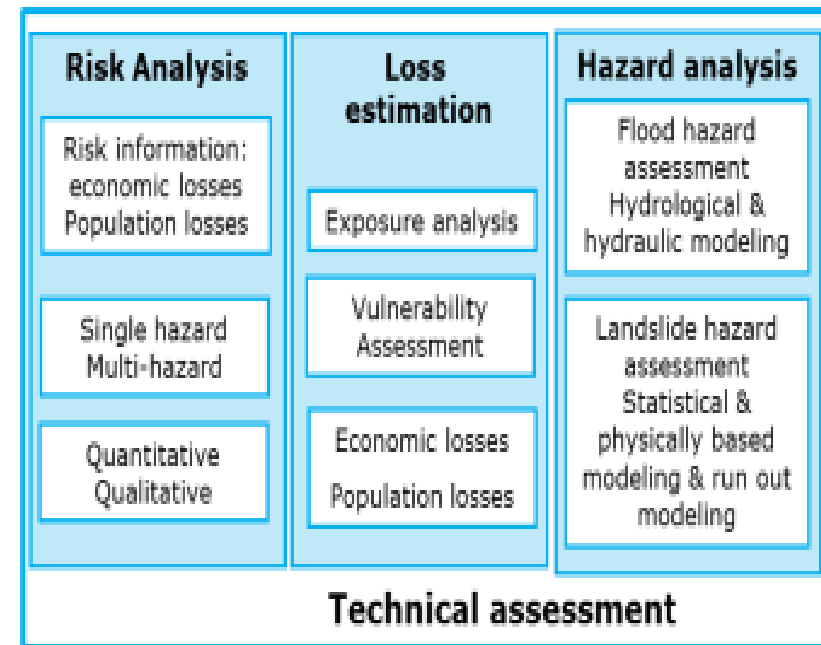
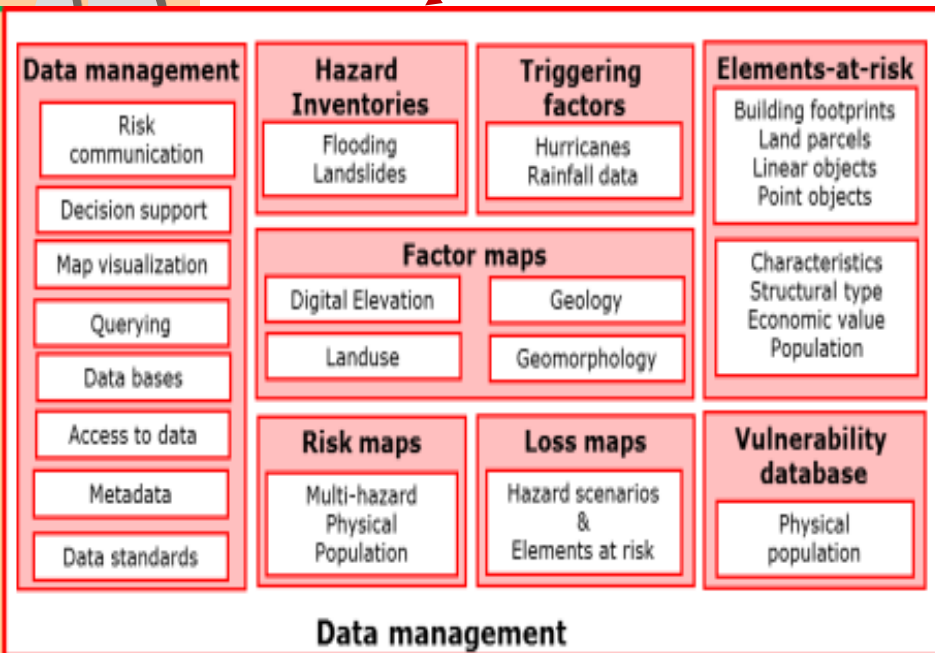


# CHALLENGES AND LESSON LEARNED

## 5. Central coordination



- Advanced technologies have been adapted to Vietnamese context but not systematical all areas.
- No scientific/central organization in charge of nationally operating all programs of landslide hazard and risk mapping







# NEXT PLANS IN PHASE I



- ❖ **Completion of inventoried landslide database, WebGIS and susceptibility maps for all Northern mountainous provinces (17 provinces)**
- ❖ **Handover 1<sup>st</sup> Phase results of SFLP to end-users**
- ❖ **Collaboration with local government for:**
  - *Community education using Project results and deliverables;*
  - *Updating landslide inventory database from communities through email, WebGIS, facebook, SMS, etc.);*
  - *Setup of a pilot landslide monitoring system.*
- ❖ **Collaboration with international experts**



# NEXT PLANS IN PHASE I



## We need:

### ❖ Scientific consultancy and staff trainings by world-wide landslide experts on:

- *Landslide zoning and mapping at different scales;*
- *Establishment of a pilot monitoring stations;*
- *Design of an early warning system for landslides.*



**Looking forwards to collaborating  
with you in the coming time!**

**Thanks for your attention !**