

Landslide and sediment disasters in VietNam

○Pham Thi Quynh ANH, Takashi GOMI
(Tokyo University of Agriculture and Technology)

1. Introduction

Vietnam is identified as one of the world's most exposed countries to multiple natural disasters, including tropical cyclones (typhoons), flooding, landslides, and droughts (Ahlheim 2009). In the recent years, landslides together with flooding have occurred widespread and became a severe problem for substantial economic losses and property damages. Annually, landslides alone cause a damage of nearly 100 million USD (Tam, 2001). An average of 430 people in Vietnam was killed each year by natural disasters from 2007 to 2011, with property losses estimated at 1% of gross domestic product. Storms and landslides damaged more than 400 bridges from 1990 to 1995 (Duc, 2009). With the natural conditions in Vietnam, landslide disasters occur annually covering all the places from high lands to delta. In this study, we summarized the extents and causes of landslides in mountainous areas in Vietnam.

Vietnam is located between 9 and 23 degrees north. Annual rainfall exceeds 1000 mm almost everywhere and become the ranges of 2000-2500 mm near the coast. Vietnam has a single rainy season during the monsoon from May to September. The country is mountainous in the northwest and in the central highlands facing the South China Sea, with the highest altitude reaching up to 2450 m. In the north around Hanoi and in the south around Ho Chi Minh City, low land regions with the Red River delta and the Mekong delta are extended. In mountainous areas, landslides usually occurred on cut slopes and alongside of roads during heavy rainfalls from May to October. Roads are damaged for days and houses and properties are damaged. Study of landslide disasters can recently be conducted for understanding the mechanism, prediction, hazard assessment, early warning, and risk management. However, the study on landslides in Vietnam is very limited except a few case studies.



Fig. 1 Landslide occurred in Sa Pa district (above) and Bac Tra My District (below) in September 2013. Photo from <http://www.news24.com/> and <http://vietnamnews.vn/>

2. Landslide and sediment disasters and their damages in Vietnam

Landslide and sediment disasters caused severe damages on economics, human life, and social materials. During recent years, the investigation and research of landslides in mountainous areas of Vietnam had been conducted especially in highly populated areas. In September 2013, floods and landslides due to heavy rain over the last three days had killed at least 21 people in northern Vietnam (Fig. 1). In November, 2013, after the huge damages of Philippines, the passage of Typhoon Haiyan caused floods and landslides in Vietnam, where 19 people were killed and over 80 thousand have fled from their homes. We summarized damages caused by landslide hazards in mountainous areas of Vietnam (Table. 1).

Some studies showed the factors for the occurrences of landslides in Vietnam. For instance, landslides in Bac Kan occurred when the continuous amount of rain exceeded 180 mm (Duc, 2013). Landslides in Binh

Dinh province in December 2005 occurred in mountainous areas from 28 to 31 degree of slope gradient. Many road failures occur in the recently populated areas. Largest landslides during the storm events occurred in Lang Chom with the volume of 22000 m³. Slope gradient ranges of 27 to 32 degrees with thinness of failure ranged from 4 to 6 m. The other landslides occurred at same time produced 10500 m³ volume of sediment with 6 to 9 m thickness.

3. Recent landslides in Vietnam

Because landslides and sediment disasters are a common natural hazard during heavy rainfall in mountainous areas of Vietnam, some recent studies for landslides gradually have conducted. Together with the development of geographical information systems (GIS) technology, many researches have been proposed and carried out in the areas with high danger for landslides in Vietnam (Bui et al., 2012). Bui et al. (2012) proposed new approach for landslide susceptibility mapping in the Hoa Binh province of Vietnam using GIS. These map showed updated information on “where” and “when” landslides potential will be occurred.

During the recent decades, landslides are significantly increased due to clear-cut logging, deforestation, and infrastructural expansion because of the rapid population growth in hilly areas. JICA also focused on the project related to the development of landslide risk assessment technology along transport arteries in Vietnam (<http://www.jica.go.jp/oda/project/1100219/index.html>). It is necessary to carry out long-term programs of investigation of landslides with the establishment of maps for potential landslides and risks. The multi-time repeating observation of landslide must also be paid more attention for the monitoring.

4. Conclusion

Landslide is a serious concern in not only Vietnam but also in the most of the southeast Asia. Therefore, understanding natural hazard in local and global scales can help us to protect our properties and natural resources. International corroboration for researches and countermeasures are essential for management and prevention of sediment related disasters.

References

- Ahlheim M., Oliver F., Antonia H., Alwin K., Minh D.N., Van D.P., Camille C., Manfred Z. (2009) Landslides in Mountainous Regions of Northern Vietnam: Causes, Protection Strategies and the Assessment of Economic Losses. *International Journal of Ecological Economics and Statistics* 15: 108-130.
- Bui D.T., Pradhan B., Lofman O., Revhaug I., Dick O. (2012) Landslide susceptibility mapping at Hoa Binh province (Vietnam) using an adaptive neuro-fuzzy inference system and GIS. *Computers & Geosciences* 45: 199–211.
- Duc D.M. (2009) Heavy rainfall induced landslides in Bac Kan and Binh Dinh province. *VNU Journal of Science, Earth Science* 25: 1-9.
- Duc D.M. (2013) Rainfall-triggered large landslides on December 2005 in Van Canh Doistrict, Binh Dinh Province, Vietnam.
- Tam D.N. (2001) Flooding and Landslides at the Highways of Vietnam, Inter. Workshop on "Saving Our Water and Protecting Our Land". Hanoi, 20-22 Oct. 2001.

Table 1. Recent recorded severe landslides & debris flow in Vietnam (Modified from Duc, 2009)

Location	Date	Type	No. of deaths and missing	Damages
Nam Cuong, Cho Don (Bac Kan province)	23 Jul. 1986	Debris flow and Landslides	7	120 ha rice fields, 20 km of roads
Lai Chan town	27 Jul. 1990	Debris flow and Landslides	Over 100	607 houses, 5 bridges, 10km ² of town demolished
Nam Muc & Muong Lay (Lai Chau province)	17 Jul. 1990	Debris flow and Landslides	20	
Muong Lay town (Lai Chau province)	17 Aug. 1996	Debris flow and Landslides	55	The commune had to move to another place
Highway No. 27 (Lam Dong province)	10 Oct. 2000	Debris flow and Landslides		37 severe landslides in 55 km, 500 m highway fully destroyed
laly hydropower plant (Kon Tum province)	since 2002	Landslide		causing damage of billions of VND each year
Du Tien & Du Gia, Yen Minh (Ha Giang province)	19 Jul. 2004	Flash Flood and Landslide	48	33 houses, 627 ha rice fields
Sung Hoang (Phin Ngan, Bat Xat, Lao Cai province)	13 Sep. 2004	Flash Flood and Landslide	23	4 houses destroyed
Nghia Lo, Van Chan (Yen Bai province)	28 Sep. 2005	Landslide	42	Cat Thinh commune and Nghia Lo tan were severely damaged
Bat Xat, Sa Pa, Bao Thang, Bao Yen (Lao Cai province)	09 Aug. 2008	Landslide	65	Many communes were destroyed
Phiang Sa, Tan Son (Hoa Binh province)	16 Feb. 2012	Landslide	6	Destroyed a selection of the national road number 6
Tong Dau and Dong Ban (Hoa Binh province)	2 Mar. 2012	Road failures		Destroyed more than 100m of the road selection and caused serious traffic problem
mountainous northern province of Yen Bai	7 Sep. 2012	Landslides	29	Coffee plantation affected by landslides
Sa Pa district in Lao Cai province	6 Sep. 2013	Landslide	21	Heavy rain over the last three days, flash floods sent rocks and soil crashing into a rural village
Quang Nam and Binh Dinh	15 Nov. 2013	Landslide	14	Typhoon Haiyan from Philippines