Integration Data and Applied Geographic Information System (GIS) Management for Landslide at Amphure Pai, Mae Hong Son

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Abstract

Natural disasters as tropical cyclone, earth quake, flash flood, flood, droughts and landslide are dangerous for life, property and economics of Thailand in every year. Landslide is one of the natural disaster that makes the most destroy. Besides, parameters that cause land slide are heavy rain and the change of landuse every year due to the forest area has been changed to agriculture filed. Therefore, landslide occurred from characteristic of geology, meteorology and landuse. The technique used weighted factors index by fix parameters that consider factors. The first is climate factor as accumulated rain. The second is physical factor as slope topography, characteristic landuse, characteristic mineral and soil. Results showed higher resolution of risk area map through villages that composed of five category risk area as follows: very strong risk area, strong risk area, moderate risk area, weak risk area and very weak risk area. The technology applied geographic information system (GIS) used to landslide management. The technique can respond to the faster events of landslide, and it can fixed area of landslide with plot Amphure Pai, Mae Hong Son through villages in output of risk area map. Therefore, it can used to preparing and reduce of life and property from landslide.

1. Introduction

Pai is one of Amphure in Mae Hong Son province suited on the North of Thailand. Natural disasters are mainly caused by the natural change but may sometime caused by human beings. There are several natural disasters different to their level of severe that causing great damage of life and properties such as flood, landslide, flash flood, tropical cyclone, thunder storm, earthquake, tsunami etc. These natural disasters even less or much destroy can unfortunately occur in any time. Landslide is the natural disaster occurring to the side of mountain caused by mass of soil and rock to move with gravity force. Landslide may be after heavy rain and flash flood. One reason of landslide is the forest destroys then no plant root hold on the soil and it makes easy to landslide.

The flood and landslide was during 8-9 October 2006. There were heavy rain and landslide at Fang district, Chiang Mai. The 15 houses in Mae-Ngon sub-district were damage while 3 houses in Mae Kha sub-district were damage and 7 were dead. There were 37 of all houses and 445 of some parts of houses were destroyed. The agricultural area was destroyed total 19,000 Rai. This damage was estimated about 100 million baht.

The flood and landslide during 12-18 August 2005 was influenced by tropical cyclone “Wachi” reduce to tropical depression and low pressure consequently. There was

heavy to most heavy rain in the North and caused sudden flood, flash flood and landslide. In Mae Hong Son, there were 9 death, 6 loss, 85 injured, 200,810 people or 43,500 households suffered. In Lam Pang, 2 were dead. In Chiang Mai, 1 was dead and properties destroyed such as 165 bridges, 373 rural roads, 389,430 Rai of agricultural area, 176 small dam, 2,135 of all over the house, 43,395 cattle, 1,480 fish farm. This damage was estimated about 300 million baht.

From primary analysis of this event, it found that the continuous heavy rain was cause of flash flood, sudden flood, and landslide. Therefore the change of land use, agricultural and growing crops that destroyed mass of tree made soil less absorbing water and no plant root hold on soil. Such eco-agricultural plants can not absolutely instead of the thick forest.

The analysis of natural disaster risk area for dividing into different risk level such as severe risk area, moderate risk area, less risk area or non risk area is an important process for warning system. It will know the target area and make warning to people in order to prepare and planning protection in time. The analysis of risk area even risk area of landslide, flood or drought has been implemented by relevant government agencies such as Thai Meteorological Department (TMD), Department of Mineral Resources (DMR), Land Development Department (LDD), Royal Irrigation Department (RID), Department of Disaster Prevention and Mitigation (DDPI). Such government agencies use GPS for the major tool to analyze and result by connecting with models developed by special field of experts. The generate result is the real data that show accurate in latitude/longitude, and range in different method and process. However, the analysis of natural disaster risk area by using GPS has 3 notices; model, scale of data, and capability of the developed program.

2. Methodology

The technique used management information System (MIS) for risk area of landslide in Amphure Pai, Mae Hong Son province. The research is analysis risk area of landslide from physical factors by fix conditions from village area that has been landslide. The geographic information system (GIS) work under many network with data based that analyses and show results in dynamics map. The map can changed depend on update data in put. The weighted factors index method used to study landslide in Amphure Pai that used two factors consideration. The first is climate as considered accumulated rain. The second is physical factors as slope in the area that can classify 5 types.

(I) Accumulated rain related landslide by consideration average rain per month;

Rainfall (mm)	Score
> 90.0	**5**
70.1-90.0	**4**
35.1-70.0	**3**
10.1-35.0	**2**
0-10.0	**1**
Rating Weighting	**10**

(II) Slop in the area

Slop	Score
>35%	**5**
16-35	**4**
8-16	**3**
3-8	**2**
0-3	**1**
Rating Weight	**9**

(III) Soil Type

Soil Type	Score
Cray	**5**
Clay 2:1	**4**
Clay 1:1	**3**
Sand & Loam	**2**
Soil compose with rock > 80%	**1**
Rating Weighting	**7**

(IV) Land Use Type

Land Use Type	Score
Bare soil	**5**
Agricultural land & Field crop	**4**
Orchard	**3**
Grass land and Disturbed forest	**2**
Dense forest	**1**
Rating Weighting	**7**

(V) Characteristic of Rock

Rock	Score
Granite / Slate	5
Metamorphic of Igneous / Quartzite	4
Limestone / Phylite	3
Gravel / Shale	2
Sedimentary	1
Rating Weighting	8

3. Results

From the result analysis for daily, 2-day and 3-day highest rain fall during July-September of 5 years (2001-2006) and the average monthly rain fall during July-September of 30 years (1971-2000) at the rainy station in the North of Thailand, it was found that: (I) The heavy rain was widespread at the upper of Wieng Nua sub-district, Mae Na Toeng sub-district and lower at the district (II) The rain in Tung Yao sub-district was less than in Wieng Nua sub-district, Mae Na Toeng sub-district due to located behind the mountain.

In the criteria warning can be considered from rainfall as follow: (I) The very strong and strong risk area during advanced 2-3 days has accrued rain not exceeded 90.0 mm. If the current day during 24 hours has more than 90.0 mm., people in such risk area should prepare watching landslide. If the accrued rain of 2 days later has exceeded 200 mm., it should immediately prepare moving out from the risk area. (II) The high and highest risk area during advanced 2-3 days has accrued rain exceeded 90.0 mm. If the

current day during 24 hours has more than 90.0 mm, people in such risk area and plain area around mountain should prepare moving out from the risk area. If the accrued rain of the day later has exceeded 200 mm, it should immediately prepare moving out from the risk area and plain area around mountain.

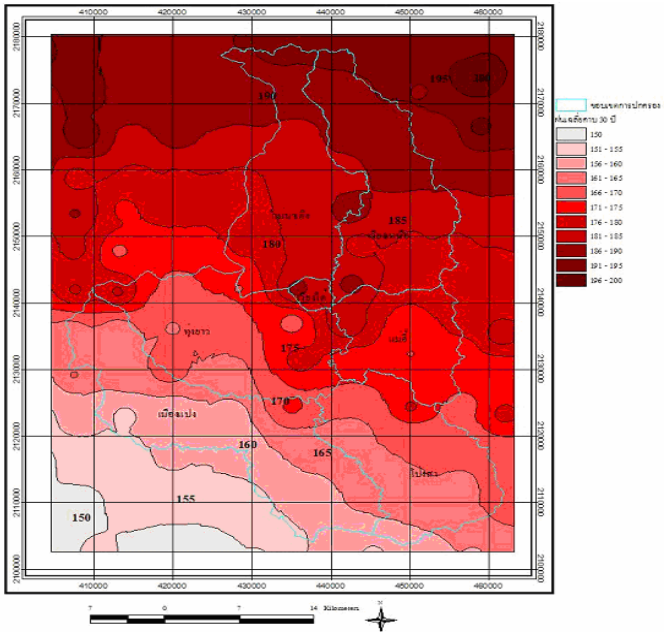

Fig. 1.1: Average rain in 30 years at Amphure Pai

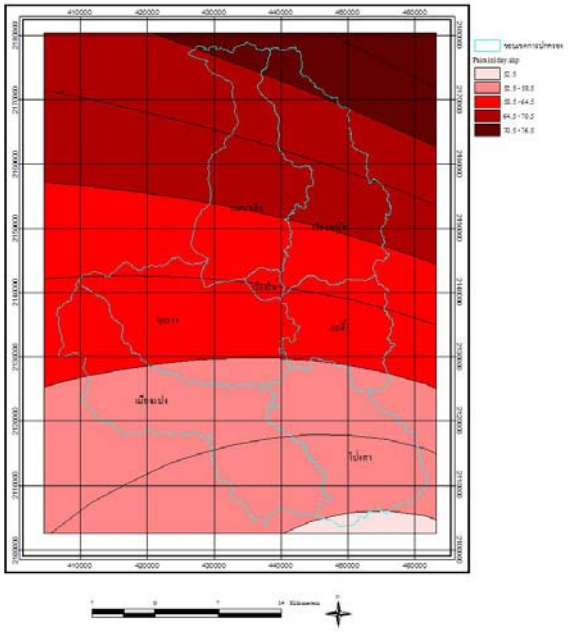

Fig. 1.2: Accumulate rain 1 day

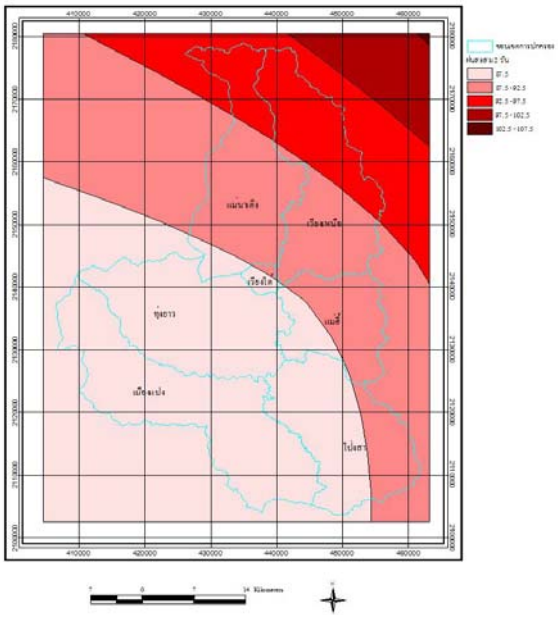

Fig. 1.3: Accumulate rain 2 day

The geography of Pai district, there are a lot of mountains around and plain in the middle like button pan. Due to the characteristic of city more mountain and quiet slop so high when it rained continuously, under ground water has high level and flow fast along to hole of soil by gravity forces with speed to the changed of the mountain from less slope to more slope. So the chap of mountain became convex form. High under ground water

spring out and brought mass of soil. When water destroyed network mass of soil while weight of water was increase, the friction force more reduced as 0. There became the first point of landslide. Therefore when the soil of toe slope was flow out, there was unstable of slope. Soil with full water has less fiction and finally follow continuous to the upper slope. When there was occurred landslide, it would follow with fast and continuous mud flow into the slope of mountain. The severe of landslide was up to the rain fall on the mountain: The slope of the mountain, the prosperity of the forest and the geological characteristic of the mountain

The analysis of severe category of landslide was shown in 3.2. The list of villages that be risk to the damage of landslide was divided into 5 levels (table 1.1) as follows: very strong risk area, strong risk area, moderate risk area, weak risk area and very weak risk area.

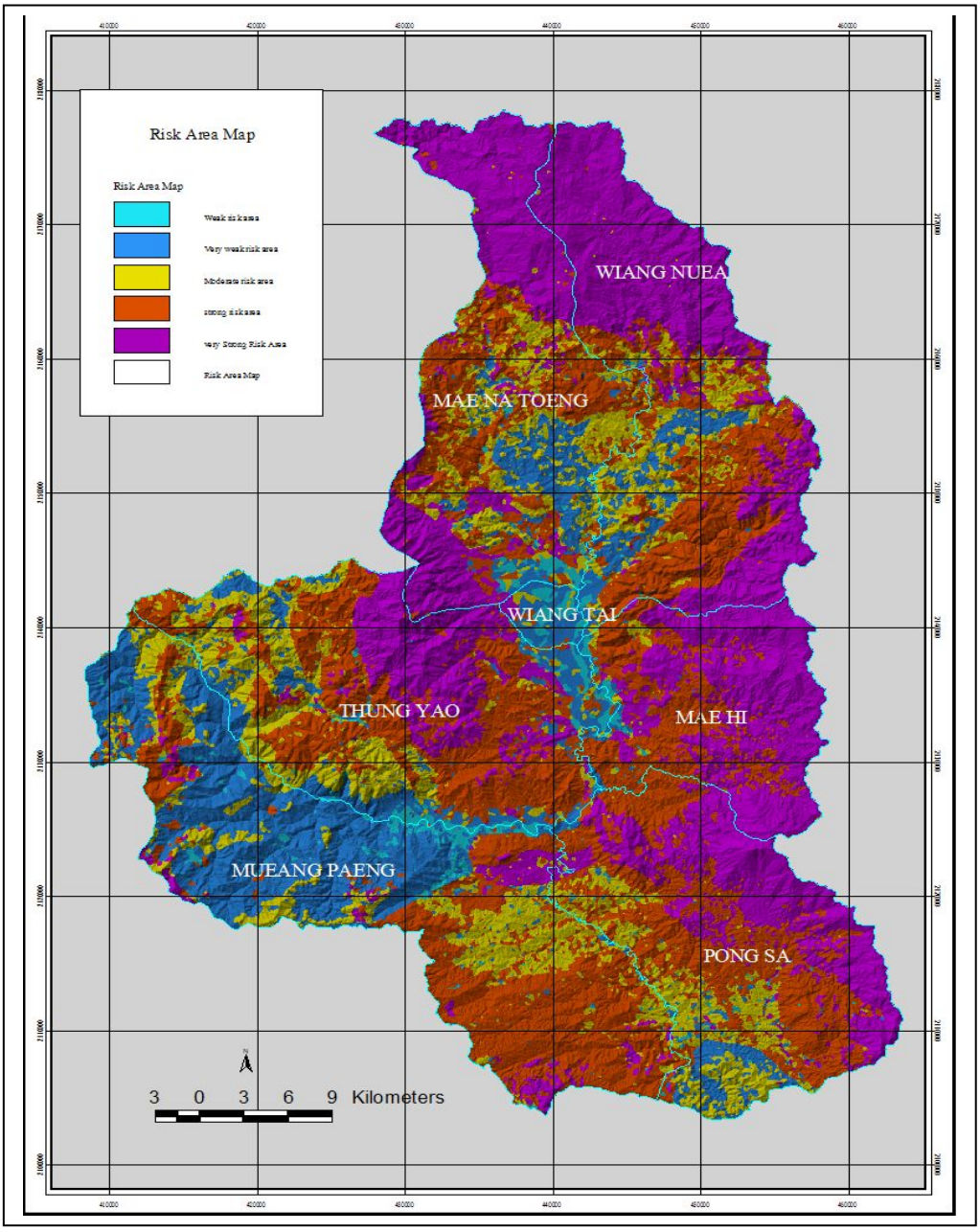

Fig. 1.5: Risk area map at Amphure Pai

Table 1.1: List of communities that be risk to landslide and risk to the damage from landslide at Pai, Mae Hong Son

Sub-district	Communities	Landslide risk
Tung Yao	Ban Tung Yao	1
	Ban Pam Pa Mak	1
	Ban Tung Yao Nua	1
	Ban Sob Pam	2
	Ban Mae Yan	2
	Ban Manora	2
	Ban Na On	2
	Ban Tong Kueng	2
	Ban King Kang	2
	Ban Pang Tong	3
	Ban Rong Yang	3
	Ban Mae Elab	4
	Ban Pam Bok	4
	Ban Tung Pong	4
	Ban Sob Soa	4
	Ban Muang Rae	4
	Ban Pam Klang	5
	Ban Teen Tat	5
Pong Sa	Ban Pong Tak	2
	Ban Mae Muang Laung	4
	Ban Huy Dua	4
	Ban Khun Sa Nai	4
	Ban Huy Rai	4
	Ban Pong Sa	4
	Ban Pang Tong	4
Muang Pang	Ban Mor Se	1
	Ban Huy Bong	1
	Ban Pha Samran	1

	Ban Sob Sao	2
	Ban Huy Mee Sri Swad	2
	Ban Don Ton	2
	Ban Muang Rae	2
	Ban Muang Pang	2
	Ban Kang Hom	2
	Ban Kang Hom Mai	2
	Ban Nam Kad	2
	Ban Huy Pom Fad	2
	Ban Huy Suk	3
	Ban Doi Mak Prig	4
	Ban Mae Loh	4
	Ban Pong Tak	5
	Ban Mai Don Ton	5
Mae Na Toeng	Ban Nai Khong	1
	Ban Na Jalong	1
	Ban Pa Yang	2
	Ban Mae Na Toeng Nok	2
	Ban Mae Khong	2
	Ban Mai Christian	3
	Ban Mae Na	3
	Ban Doi Phi Lu	3
	Ban Nam Pla Lung	4
	Ban Pang Pak	4
	Ban Sai Ngam	4
Mae Na Toeng	Ban Muang Soi	4
	Ban Mae Na Toeng Nai	4
	Ban Ya Poe	5
	Ban Moh Pang	5
	Ban Na Jong Long Mai	5
Mae Hie	Ban Klang	1
	Bang Mae Ping	1

	Ban Pong Mai	1
	Ban Sai Khao	1
	Ban Ta Pai	2
	Ban Mae Yen	4
	Bang Mae Ping Noi	5
	Ban Huy Kaew	5
Wieng Tai	Ban Huy Pu	1
	Ban Wat Luang	2
	Ban Hua Na	2
	Ban Mai Saha Samphan	3
	Ban Pong	3
	Ban Nam Hu	4
	Ban San Ti Chon	5
Wieng Nua	Ban Hong	1
	Ban Sri Don Chai	2
	Ban Huy Chabg Tao	3
	Ban Pa Sang	4
	Ban Hua Mae Muang	4
	Ban Tan Chet Ton	4
	Ban Pang Song Ngae	5
	Ban Huy Hok	5
	Ban Muang Noi	5
Wieng Nua	Ban Mai	5
Pai Municipality	Ban Chao Moh	2
	Ban Pa Kham	2
	Ban Muang Prao	2
	Ban Muang Prae	2

4. Conclusion

Results showed landslide risk area and can a classified five levels as very strong risk area, strong risk area, moderate risk area, weak risk area and very weak risk area. The research is being GIS technology management can be identified and targeted for mitigation. Therefore the characterization of the landslide in the context of the catchments

and the integration of the public perception of the landslide hazard map in order to create more adequate actions for protection of the affected people in the area.

Reference

[1] Asian Disaster Preparedness Center, 2005, Disaster Risk Management in Asia. Bangkok : Clung Wicha Press Co.ltd,

[2] Gyeltshen P, Dorji.2007, Landslide harzard and risk assessment of Doi Suthep-Pui area in Chiang Mai province, Northern Thailand. Master of Science in Environmental science Chiang Mai : The Graduate school Chiang Mai University,

[3] Shelia B, Reed.1997, Introduction to Hazards, Disaster Management Training Programme,

[4] Ministry of Energy, Mines and Petroleum Resources (EMPR), Government of British Columbia.
http://www.empr.gov.bc.ca/Mining/Geolsurv/Surficial/landslid/ls2.htm