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Country Reports

Report of Thailand on Cartographic Activities During the Period of 2007-2009*

* **Prepared by Thailand**

Report of Thailand on Cartographic Activities
During the Period of 2007-2009

This country report of Thailand presents in brief the cartographic activities during the reporting period 2007-2009 performed by government organizations namely Royal Thai Survey Department , Hydrographic Department and Meteorological Department.

The Royal Thai Survey Department (RTSD)

The Royal Thai Survey Department is the national mapping organization under the Royal Thai Armed Forces Headquarters , Ministry of Defense. Its responsibilities are to survey and to produce topographic maps of Thailand in support of national security , spatial data infrastructure and other country development projects. The work done during 2007-2009 is summarized as follows.

1. Topographic maps in Thailand

Topographic maps in Thailand were initiated in the reign of King Rama the 5th. In 1868, topographic maps covering border area on the west of Thailand were carried out for the purpose of boundary demarcation between Thailand and Burma. Collaboration with western countries, maps covering Bangkok and Thonburi were produced. During 1875, with farsighted thought in country development, King Rama the 5th established Topographic Department serving road construction in Bangkok and set up telecommunication network from Bangkok to Pratabong city. Besides, during this period of time, maps covering Thai gulf were produced serving marine navigation use.

In 1881, Mr. Mcarthy from the United Kingdom was appointed as director of Royal Thai Survey Department (RTSD), previously known as Topographic Department, and started conducting Triangulation survey in Thailand. In addition, the Triangulation network was extended to our neighboring countries like Laos and Cambodia, and as a result topographic maps, scale 1:2,000,000 covering this network were produced. Also, maps with scale 1:100,000 over central area of Thailand were completed.

During 1901 to 1971, applying new mapping technology, various map series have been produced which the important among them are : cadastral maps, hydrographic maps, L7017 maps and thematic maps. To comply with new mapping applications, new datum, WGS84, has been used in a new L7018 map series, scale 1:50,000 covering entire country. Subsequently, in 2008, map series 1501, scale 1:250,000 covering the whole country was completely produced.

At present, RTSD continues updating both L7018 and 1501 map series in according with fiscal plan as L7018 be completed in 2009 and 1501 in 2010. These two map series are considered base maps of the country which RTSD, as a custodian, has to keep current geographic details within every five years. The approach used for map update is through aerial photography and satellite images from SPOT5 and THEOS in the near future.

Future plan in photogrammetric approach, RTSD is in progress of creating feature level database containing all geospatial information in diverse levels. This database is expected to use for conducting different map applications for instance GIS, map update, maps on demand and map services.

2. Cartographic Activities of Geography Division

In 2008 – 2009, RTSD produced administrative boundaries map of Thailand at the level of sub district. These maps are produced in A3 size and they are currently kept in the database.

3. Geodetic Activities

3.1 Introduction

The Royal Thai Survey Department is responsible for land and air surveying activities and producing topographic maps for official and public use . In addition, it is also engaged in the field of Geodesy and Geophysics of which various activities were conducted during the period under review, 2007 – 2009 . These are as follows :

3.2 Horizontal Control Network (GPS Network)

Geodesy and Geophysics Division, The Royal Thai Survey Department (RTSD) is responsible for the establishment of Geodetic Network in Thailand using GPS . The GPS observation has been performed since 1991 and its networks are continuously developed up until now. Moreover, RTSD had participated in various international projects of GPS observations namely Project on monitoring tectonic motions, THAICA Project done with the German Institut fur Angewandte Geodesic : IFAG, the Project on determination of coordinates in WGS 84 datum using relative point positioning technique done with the National Imagery Mapping Agency : NIMA, Project on the joint survey and demarcation with the neighboring countries, Project on Geodesy and Geodynamics Research using GPS data for the purpose of monitoring tectonic motions and deformations which is presently carried out with the Delft Institute for Earth-Oriented Space Research (DEOS), Netherlands.

The results coming out from the participation in the aforementioned projects make the GPS Thailand Network acquire not only the observed data but also the accurate and reliable control stations. At present, RTSD is conducting the L 7018 Recompilation Project. The datum in the new map series will be WGS 84. As a result of this, Geodesy and Geophysics Division, RTSD has performed the network adjustment covering the whole country in order to make the network not only become more accurate but also reach the unity. This network will be further used as the reference network for other concerned projects and eventually for country development as well as for the scientific and geodetic analysis.

As mentioned earlier, in order to improve the GPS Network of RTSD become more reliable, the adjustment of network is made in accordance with FGCC (Federal Geodetic Control Committee, 1989 (USA.) standard.

The Network of RTSD is divided into 3 levels as follows :

1) Reference Frame (Zero Order Network) use for the Project on monitoring tectonic motions, THAICA and GEODYSSEA Projects consisting of 8 stations such as GPS 3001 Uthai Thani province, GPS 3052 Srisaket province, GPS 3166 Bangkok ,GPS 3217 Lampang province, GPS 3315 Chumphorn province, GPS 3405 Pattani province, GPS 3427 Chonburi province, GPS 3657 Phukhet province and GPS 3671 Pattani province. Reference coordinates are in ITRF system during the time of 2005.7. At present,

2) Primary Network (First Order Network) It is determined in Class A as standardized by FGCC. This network which is extended from the Zero Order Network was first observed in 1999. There are 19 stations included in the First Order Network (including 8 stations as specified in item 1). The interval in each station is about 250 kilometers.

3) Secondary Network (Second Order Network) It is determined in Class B as standardized by FGCC. This network is extended covering the entire country with the total of 95 stations. The interval in each monument is about 80 kilometers.

All the said network has been re-established after Sumatra-Andaman and Nias earthquakes in 2004 and 2005 .

In conclusion, RTSD GPS Network is highly reliable and consistent with FGCC's standard. All stations from GEODYSSEA and THAICA Projects in ITRF system during the time of 2005.7 are used as the National Control stations. RTSD GPS Network is also used for studying the geodynamics with DEOS, the Netherlands Institute.

In the future, RTSD will use GPS satellite technique for the identification of Mean Sea Level (MSL) instead of using Leveling technique. At present, Geodesy and Geophysics Division, RTSD is studying and developing the local datum using data obtained from GPS and Leveling Network for adjustment.

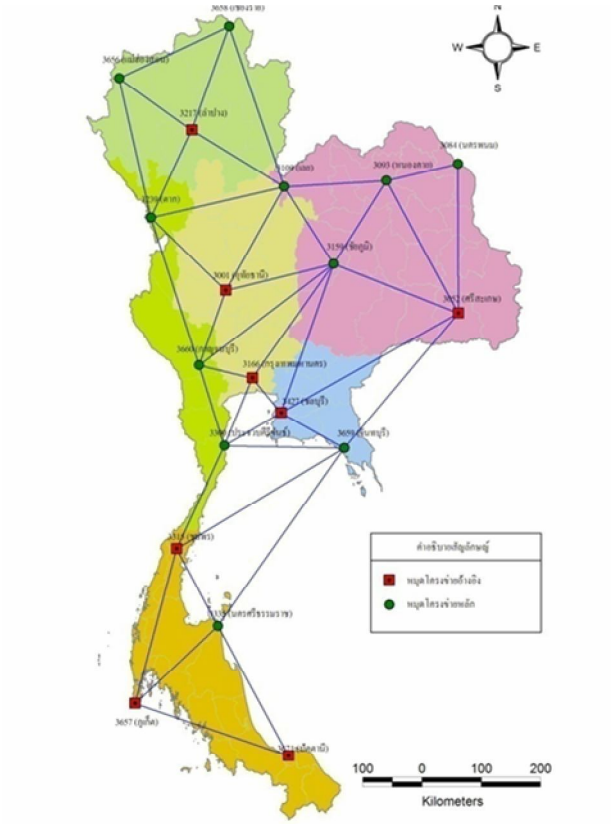


Fig. 1 Zero and First order GPS stations of Thailand

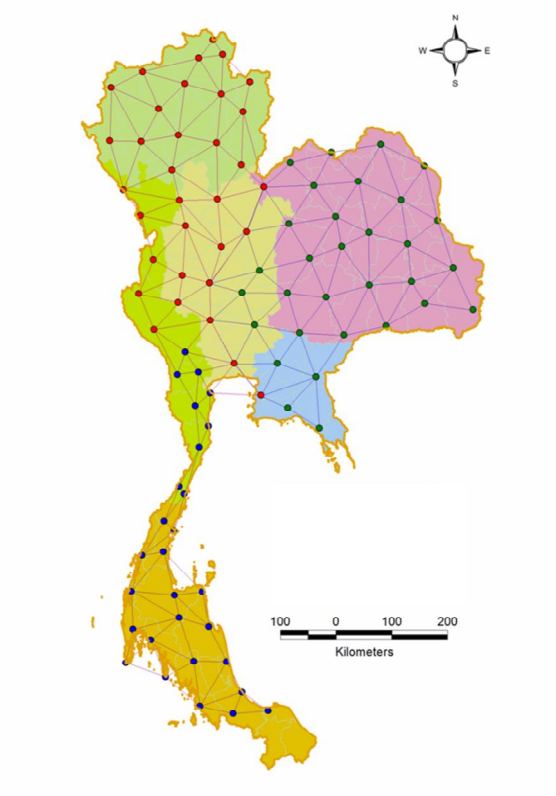


Fig. 2 Secondary Network of GPS Stations of Thailand

3.3 Vertical Control Network

The first order leveling network of Thailand was extended from the tidal datum (Mean Sea Level) at Ko Lak to every part of the country. The first order leveling were carried out to densify the network with a total establishment of 9656 Benchmark. All observation data in the leveling network were prepared and ready for simultaneous adjustment.

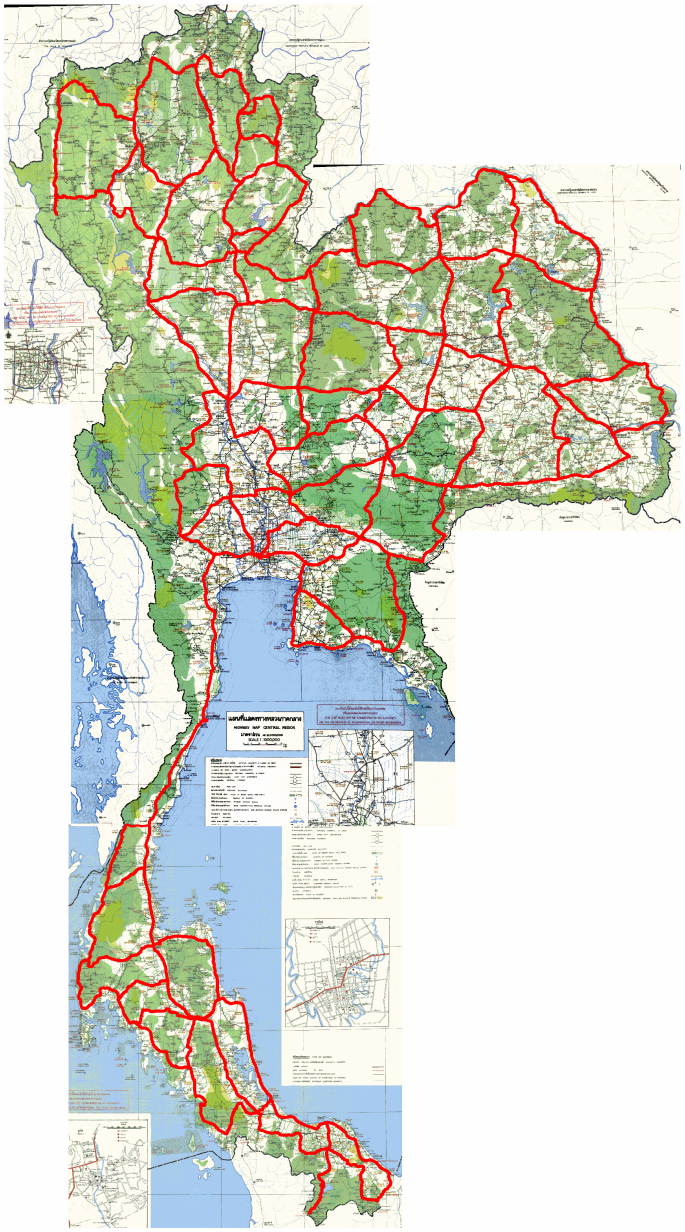


Fig. 3 First order leveling network of Thailand

4. Map Information Center

4.1 Introduction

Royal Thai Survey Department (RTSD) is responsible of assembling, maintaining, and serving map-base for the government and private organization. Other essential tasks are to modernize database system and make appropriate data for service and take charge of mapping center following the UN solution of the map of Asia and Far East. Many mission involve GIS had been processed by Map Information Center (MIC) in 2007-2009 and those are expressed below.

4.2 Geo-spatial Service

1) Map Service

MIC is one particle, but vital supporter of national and social development by planning with our products. Although the expenses which can purchase our products are not so high, our product would cause certainly more effective and accredited assistances of all planning upon our products in Figure 1. During 2007- 2008, our products can be distributed to more than two thousand organization and/or agencies.

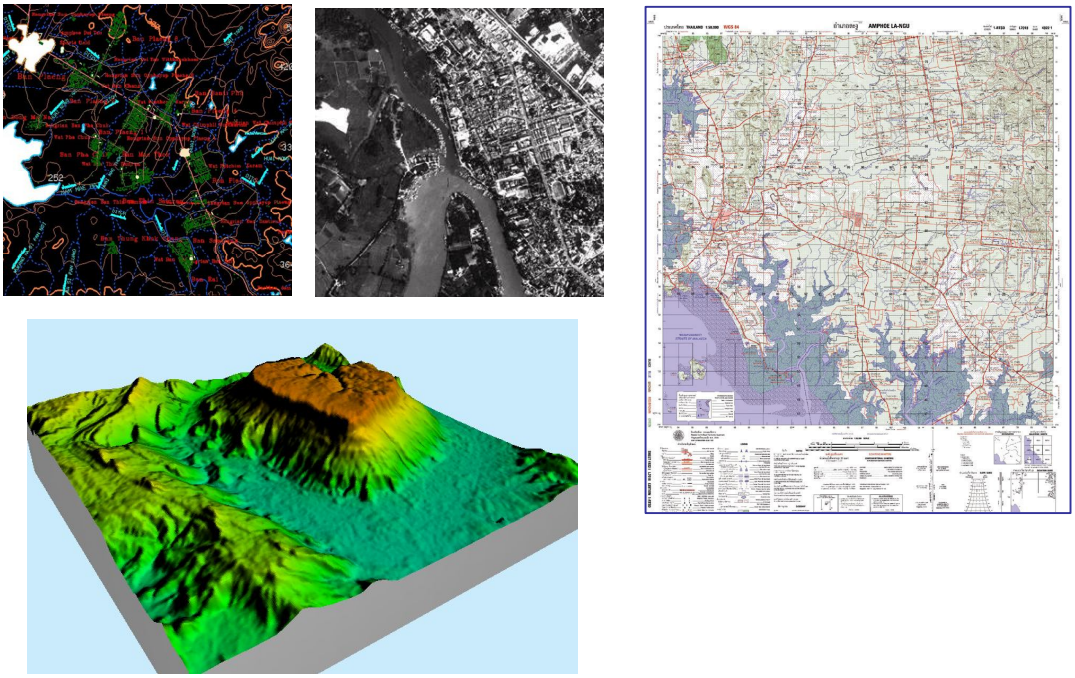


Figure 1: Example of products from MIC

Recently, RTSD initiates the new service system, namely the one stop service, which is the part of Quick Win Initial project of Royal Thai Armed Forces Headquarter (RTAFH). The conceptual of this project emphasizes on the increasing efficiency of service and the rapidly serving product to customers. This project can provides the comfortable service for customers more than the past service system such as map query, shipping product, and e-Commerce service. Hence, customers can search our serving products and order them from their home and/or work using internet. Both hard and soft products can be delivered to customers by mail.

2) On-line Service

Nowadays, RTSD has developed on-line data service - internet GIS - to customers. The on-line data service can be categorized into two scenarios. First, RTSD has developed Web Map Service (WMS) to serving geo-referenced map images over the internet that are generated by RTSD map server using data from a GIS database. The standard of transferring data, RTSD applies the Open Geospatial Consortium (OGC) as reference. Another development is to display geo-referenced data on the internet browser (web application) for customers don't have GIS software (thin client).

3) Value-added product

The Map 3-Dimension system is the one of system which applies RTSD products including Raster map, Vector map, Orthoimage, Satellite image and Digital Terrain Elevation Data to create the 3-dimensional products. This system can construct 3D buildings, generate pilot flights, and simulate events into products. Up until 2009, it is more than 100 3D products that support to organization and agencies especially (RTAFH). Moreover, this system can serve products to customers in off-line and on-line.

Figure 2: Example of 3D products supporting government and civilian

4) Spatial Data Infrastructure (SDI) Participation

- Fundamental Geographic Data Set (FGDS)

At the moment, the National GIS committee in Spatial Data Infrastructure obviously announces some parts of the policy of the base feature and the responsibility of involving organization. The first announcement is to specify base maps in Thailand which are 1:250,000 1:50,000 1:25,000 1:10,000 and 1:4,000. The National GIS committee intends to create an environment in which all stakeholders can cooperate with each other and interact with technology, to better achieve their objectives at different political/administrative levels. Data sharing enables users to save resources, time and effort avoiding duplication of expenses associated with generation and maintenance of data and their integration with other datasets. Furthermore, the National GIS committee passes the plan of development of national GIS and the integrating budget plan (four year plan: 2006-2009). The National GIS committee also assigns 4 base features - aerial photo, geodetic control, digital elevation model, and topographic map - of FGDS to RTSD is responsibility. During 2006 – 2009, RTSD has developed the producing FGDS plan in five ways; (i.) collecting surface height using Light Detection and Ranging (LIDAR) (ii.) digital aerial camera system (iii.) automatic mapping (iv.) topographic survey and classification system (v.) real-time GPS Base Station.

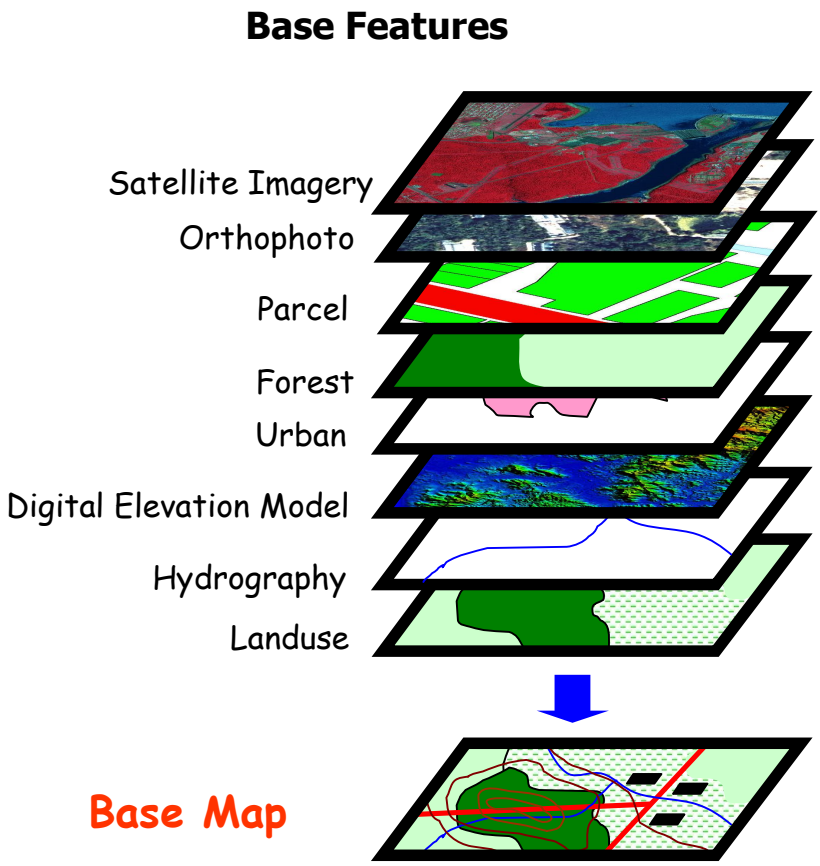


Figure 3: Base features of NSDI

Following the policy of the National GIS committee desires RTSD to takes charge of base map in three scales such as 1:250,000 1:50,000 and 1:25,000. The GIS database structure of L7018 consists of eleven layers - boundary, elevation, hydrography, population, vegetation, industry, physiograpy, transportation, aeronautical, general data, and margin. The cycle of updating the L7018 map series is 5 year. The latest L7018 is the 3rd edition which is published at the present time. The updating method applies THEOS imagery as reference to collect and modify topographic map.

The developing FGDS makes profit to government in several ways. First, government can be illustrated the recent information in all part of country. This is the effective management tool for the government. Second, the government will have standard, unique, non-redundant, modernized, and consistency data because data will be updated by using satellite imagery. Lastly, the government efficiently manages budget in GIS. RTSD has plans and projects that can support government to implement data. Moreover, this developing database can join with MIS.

- Spatial Data Infrastructure Center

By Cabinet's resolution for fulfillment of National Data clearing house within 2005, twin nodes of National Data clearing house were defined and installed at RTSD and GISDA. At RTSD, MIC was in charge of clearing house's installation in 2005. Nowadays, the National Geo-spatial information center gives emphasis to support connection network and GIS data

through internet for serving government and civilians. Service can separate into two groups; serving public data and specification data for headquarter. The main work of serving public data is to develop FGDS structure such as inputting data to clearinghouse system (leveling query system up to international) and developing mapping system on internet.

5. Challenges

The challenge of RTSD has to be accomplished that continually update data into near real time with the least time. Furthermore, the service has to efficient support for varied needs of customers by giving attention in developing Service Oriented. This development would support 3G technology which can develop to Mobile GIS. The development will transform data structure into the National Enterprise GIS Infrastructure which can conveniently enlarge and modify.

The Hydrographic Department

1. Hydrographic Office / Service

Hydrographic Department, Royal Thai Navy (HDRTN) located in Bangkok, THAILAND Director General : VADM. Nakorn Thanuwong Principle Tasks including :

- Surveying and Producing of Navigational Charts in Thai Waters
- Aids to Navigation Maintenance
- Oceanographic Survey and Tidal Prediction
- Marine Meteorological Forecast
- Standard Time Keeping
- Navigational Equipment Procurement and Maintenance

Fig. 1 Hydrographic Department, Royal Thai Navy

2. Surveys

Hydrographic Department, Royal Thai Navy (HDRTN) is a national authority responsible for various hydrographic services of Thailand. The main tasks are to provide services to serve marine navigational safety in Thai waters, military defense requirements and sustainable country development. To support such mentioned roles, HDRTN has been conducted the hydrographic survey in Thai waters for nautical chart production covering the gulf of Thailand and Andaman sea. The activities and developments during the period of 2007-2009 are as follows:

During the year 2007-2009 the HDRTN has conducted 23 hydrographic surveys. The results of this surveys were implemented for production of nautical charts and other charts utilized in the navy.

Type of survey	**2006**	**2007**	**2008**	**2009**
Habour survey	2	4	1	-
Coastal survey	2	1	-	2
Off-shore survey	-	1	-	-
Survey for update chart	6	3	-	1
Total	**10**	**9**	**1**	**3**

HDRTN has tried its best to improve the hydrographic survey to meet the standard of the IHO (International Hydrographic Organization) by conducting survey based on WGS 84 and improving the habour survey by using the multi-beam echo sounder. Hydrographic Surveys has been performed by using vessels named HTMS. Chandhara and HTMS. Pharuehatsabodi

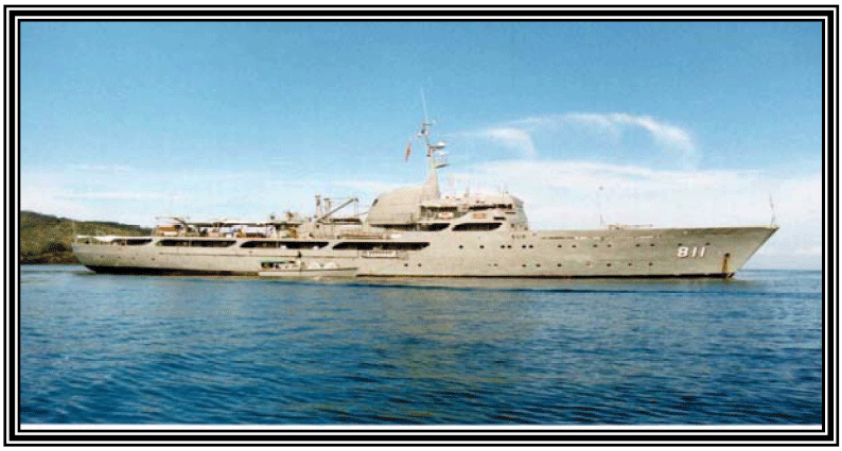


Fig. 2 “HTMS. Chandhara”

Fig. 3 HTMS. Pharuehatsabodi

3. New Charts and Updates

Paper chart production activities: The surveys mentioned above were used to produce Thai nautical charts and other related charts in Thai waters. Nautical charts produced during the year 2003- 2006 are shown as below:

Type of production	2006	2007	2008	2009
New chart	2	2	-	3
New publication	4	1	5	-
New edition	5	4	7	5
New print	1	-	-	-
Total	**12**	**7**	**12**	**8**

3.1 Paper Charts produced in 2009

New charts:
- No.112A, Pak Mae Nam Chao Phraya, 1:22,000, WGS84
- No.229A, Entrance to Songkhla Harbour, 1:12,000, WGS84
- No.244, Pak Phanang to Laem Kho Kwang, 1:80,000, WGS84

New Edition Charts:
- No.112, Entrance to Mae Nam Chao Phraya, 1:45,000, WGS84
- No.118, Ko Saba to Ko Chick Nok, 1:60,000, Indian 1975
- No.121, Ao Trat, 1:50,000, Indian 1975
- No.147, Ko Lan to Laem Phatthaya, 1:22,000, WGS84
- No.308, Phuket to Kantang, 1:200,000, Indian 1975

3.2 Electronic Navigational Chart

Thai ENC Production has been started in 2003 up until now, totally 42 cells already produced. All ENC are covering Thai Gulf (right side of Thailand) and Andaman Sea. Thai ENC have been done by quality assurance according to IHO-S-58 and released commercially since January 2007. Moreover, 42 ENCs are covering 10 Thai main shipping routes.

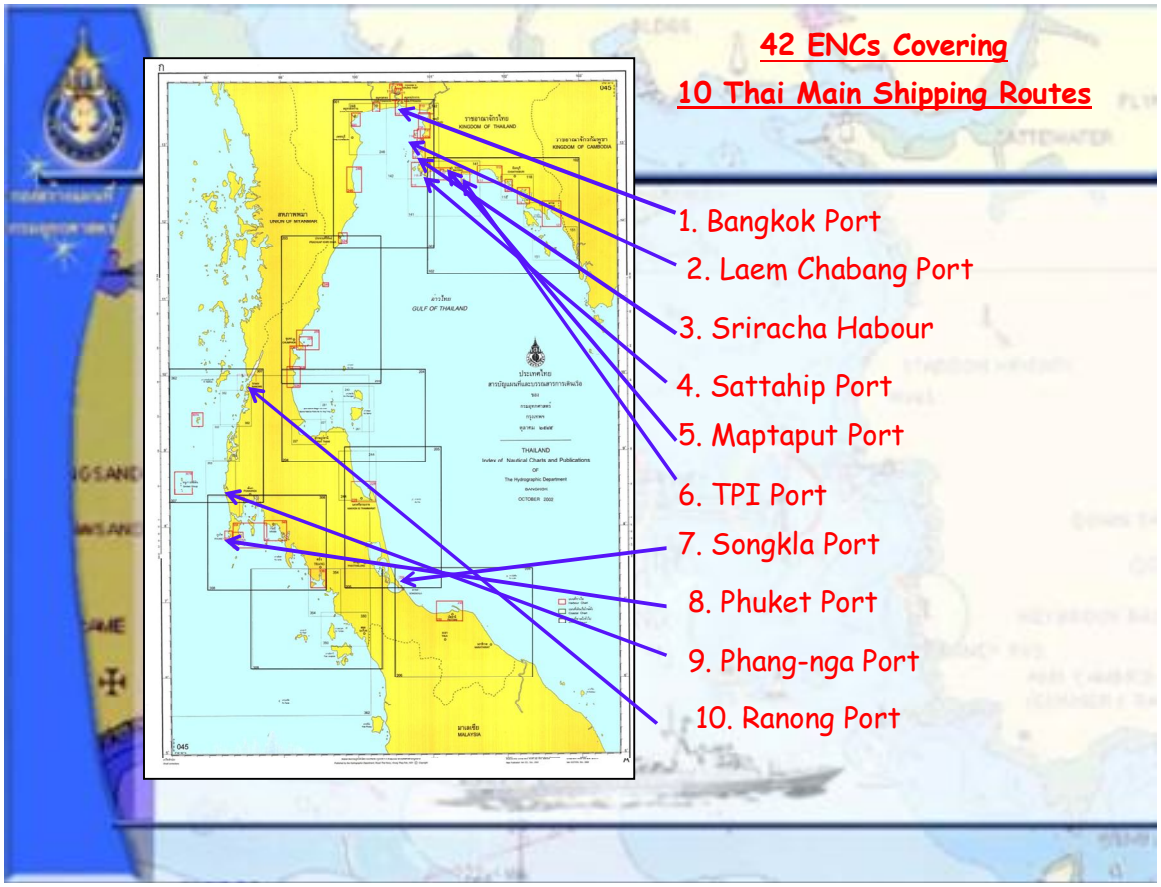


Fig. 4 10 Thai main shipping routes.

Thai ENC Status at September 2009 (10 Main Shipping Routes)

No.	Cell Num	Title	Scale	Band	สถานะ	Issue Date
1	TH100045	Krungthep to Singapore	1,500,000	Overview	Service	20090601
2	TH100362	Satun to Ranong	700,000	General	Service	20090701
3	TH100066	Laem Mae Ramphueng to Ko Kong	350,000	General	Update+QA	
4	TH100067	Pak Phanang to Ko Thalu	350,000	General	Update+QA	
5	TH100068	Kelantan to Laem Talumphuk	350,000	General	Update+QA	
6	TH400163	Map Ta Phut Industrial Harbour and Approaches	22,000	Approach	NeedSurvey	

7	TH400164	Siracha and Approaches	22,000	Approach	Service	20090601
8	TH500169	Entrance to Thai Petrochemical Industry Port	22,000	Approach	Service	20090601
9	TH400115	Ao Sattahip and Approaches	45,000	Approach	Service	20090601
10	TH400171	Ko Phai to Ko Lan	22,000	Approach	Service	20090601
11	TH400335	Phuket Harbour	22,000	Approach	Service	
12	TH400112	Entrance to Mae Nam Chao Phraya	45,000	Approach	Service	
13	TH400229	Songkhla Harbour	45,000	Approach	Service	
14	TH400331	Entrance to Ranong	45,000	Approach	NeedSurvey	
15	TH400332	Ko Phra Thong	45,000	Approach	Update+QA	
16	TH400334	Phuket Harbour and Approaches	45,000	Approach	NeedSurvey	
17	TH400352	Ko Khai Yai To Ko Phayam	45,000	Approach	NeedSurvey	
18	TH400353	Ban Thai Muang to Chong Pak Ko	45,000	Approach	Service	20090701
19	TH400138	Mae Nam Chao Phraya from Samut Prakan to Phra Ram VI Bridge	22,000	Approach	NeedSurvey	
20	TH400147	Ko Lan to Laem Phatthaya	22,000	Approach	Service	20090601
21	TH40112A	Pak Mae Nam Chaophraya	22,000	Approach	Service	20090801
22	TH300001	Gulf of Thailand, Prachuap Khiri Khan to Ko Chaung	180,000	Coastal	Service	20090601
23	TH300102	Ko Chuang to Ko Kong	180,000	Coastal	Service	20090601
24	TH300203	Lang Suan to Prachuap Khiri Khan	180,000	Coastal	Service	20090601
25	TH300204	Laem Kho Kwang to Lang Suan	180,000	Coastal	Service	20090601
26	TH300205	Songkhla to Laem Kho Kwang	180,000	Coastal	Service	20090601
27	TH300206	Songkhla to Kelantan	180,000	Coastal	Service	20090601
28	TH300307	Phangnga to Ranong	180,000	Coastal	Service	20090601
29	TH300308	Phuket to Kantang	180,000	Coastal	Service	20090601

30	TH300141	Laem Thoraphim to Ko Khram	90,000	Coastal	NeedSurvey	
31	TH300142	Pak Nam Chao Phraya to Ko Raet	90,000	Coastal	NeedSurvey	
32	TH500114	Ko Sichang Habour	12,000	Harbour	Service	20090601
33	TH500137	Si Racha	12,000	Harbour	Service	20090601
34	TH500156	Leam Chabang Port	12,000	Harbour	Service	20090601
35	TH500157	Map Ta Phut Industrial Harbour and Approaches	12,000	Harbour	NeedSurvey	
36	TH400170	Thai Petrochemical Industry Port	12,000	Harbour	Service	20090601
37	TH50115A	Sattahip Commercial Port (Chuk Samet Harbour)	8,000	Harbour	Service	20090601
38	TH50111A	Bangkok Port	4,000	Harbour	Service	20090601
39	TH50335A	Ao Man and Approaches	8,000	Harbour	Service	20090801
40	TH500111	Krungthep Port Zone 2	12,000	Harbour	Service	20090601
41	TH500260	Prachuap Khiri Khan harbour	12,000	Harbour	NeedSurvey	
42	TH50229A	Entrance to Songkhla Harbour	12,000	Harbour	Service	2090801

The mariners can visit HDRTN website for more details and also download ENC monthly update file every on the 5th of the month on ***www.navy.mi.th/hydro/chartservice.***

3.3 INT Charts Activities

For INT Chart in Area J, HDRTN is responsible for 4 INT Charts on the Andaman Coast which were informed to National Hydrographic Office of India for consideration of INT Chart No. as follows.

INT No.	Producer	National No.	Scale 1 :
***	TH	362	700,000
***	TH	-	300,000
***	TH	335	20,000
***	TH	335A	20,000

4. New Publication and Updates

- Tide Table 2009
- Table of Moon – Sun Rise/Set 2009

5. Marine Safety Information

Notice to Mariners both in Thai and English languages have been distributed daily through the Navy Radio Station and Radio Station for Navigation (Bangkok Radio). The information issued to mariners are mostly concerned with Chart correction, Aids to Navigation status, Ship wrecks, Navy Exercise, and Oil & Gas Exploration Activities.

The Meteorological Department

1. 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.

2. 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 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 Wachi cyclone reduce to tropical depression and low pressure consequently. There was heavy to most heavy rain in the North and caused sudden flood and 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 (DDPM). 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 area 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.

3. 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. 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

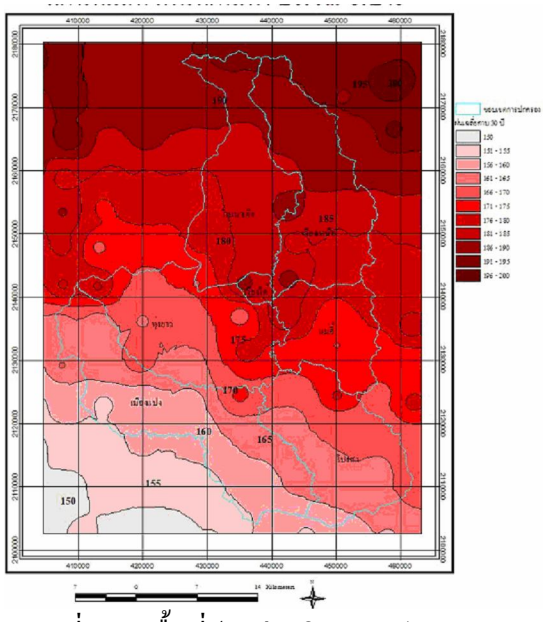
Rock	Score
Granite / Slate	5
Metamorphic of Igneous / Quartzite	4
Limestone / Phylite	3
Gravel / Shale	2
Sedimentary	1
Rating Weighting	8

4. 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.

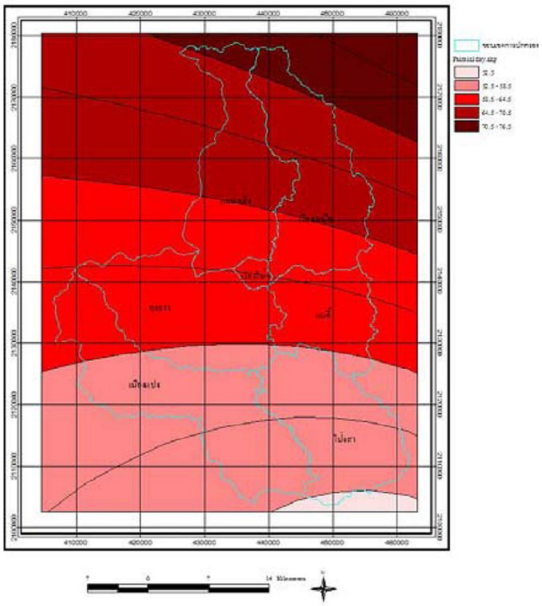
Warning Criteria can be considered from rain fall as follow: (I) The very strong and strong risk area during advanced 2-3 days has accrued rain not exceeded 90.0 mm. If the current day during 24 hours has more than 90.0 mm., people in such risk area should prepare watching landslide. If the accrued rain 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.



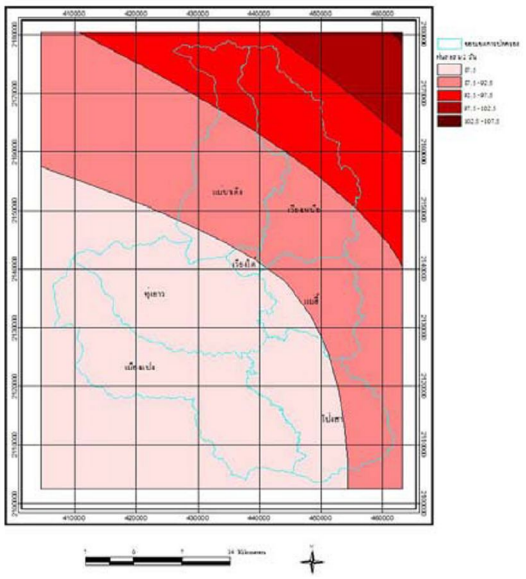
แผนที่แสดงพื้นที่ฝนเท่าบริเวณ อ.ปาย

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



แผนที่แสดงเส้นฝนเท่าสะสม 1 วัน บริเวณ อ.ปาย

Fig. 1.2: Accumulate rain 1 day



แผนที่แสดงเส้นฝนเท่าสะสม 2 วัน บริเวณ อ.ปาย

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 ands 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.

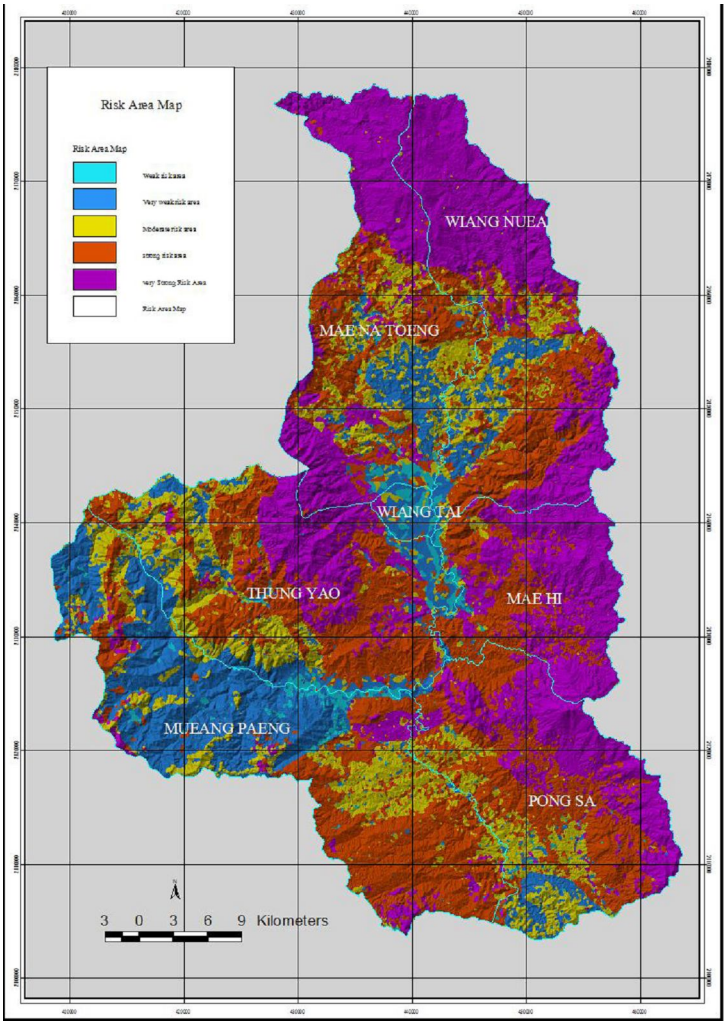


Fig. 1.5: Risk area map at Amphure Pai

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

Sub-district	Communities	Landslide risk
	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

Sub-district	Communities	Landslide risk
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

5. Conclusion

At present use more data to integrate and show results in graphic, then the geographic information system one of tool. It can integration all data such as hydrology, meteorology, landuse, satellite, population. The role of technology geographic information system in applied used to many organizations. It is very used to preparing such as applied to use in the early warning system, Earth quacks management and Landslide management. Landslide is one of

major use geophysics information system. It can respond to the faster events. It easy checked data were changing by update. Therefore, it is research used the geographic information system management of risk area from landslide. It can fixed area of landslide and plot risk area map in Amphure Pai, Mae Hong Son through villages. It can used to preparing and reduce of life and property from landslide.

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