# APPLICATION OF REMOTE SENSING AND GIS FOR RENEWABLE RESOURCES DAMAGED BY TYPHOON 'GAY' : CHUMPHON PROVINCE

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**Abstract :**

On the 4th of November in 1989, Thailand encountered the natural disaster caused by typhoon 'Gay' with it's velocity near the storm's center of about 120 kilometer/hour. It extremely damaged the people of Chumphon Province in the southern part of Thailand. Remotely sensed data was only one source of information used to assess the degree of damage and to identify the areas. It was estimated that about 250,675 hectare of damaged were agricultural land with 446 deaths and 154 people injury. A number of 38,002 houses were destroyed causing 153,472 people being homeless.

Due to this natural disaster, the Thai government had to set the urgent policy, both short and long term development plans, in order to regain the normal life of the people who are living in this area. Land Use Planning Division, Land Development Department, Ministry of Agriculture and Cooperatives was assigned to make proper land use plans to renew the damaged resources particularly agricultural areas. Recent advances in remote sensing technology and GIS has provided new and powerful tools for assisting resource planners and managers to use information effectively in making decisions on resource allocation and development.

This paper will discuss how remote sensing and GIS can be applied to solve these problems rapidly and economically.

**Key Words** : Remote Sensing, GIS, Renewable Resources.

## Background

Thailand locates in the central part of Indochinese peninsular as well as the entire Southeast Asian region and covers an area of 550,000 $km^2$ approximately. It lies latitudinally between $5^0$ 45' and $20^0$ 30' North and longitudinally between $97^0$ 30' $105^0$ 45' East. It has common frontiers with the laos People's Democratic on the North and Northeast; with the Kampuchea on the East; and with the Burma on the North and West. Peninsular Thailand is bounded on the South by Malaysia. The population is about 56 millions with an annual rate of increase of about 1.3 %.

Thailand has a climate dominated by the monsoon. Most of the country can be classified as tropical savannah with the exception of the east and southern peninsular, where tropical monsoon predominates. There are three main seasons namely: a rainy season from May to October; a cool-dry season from November to February and a hot-dry season from March to May. The southern and eastern coast of the country receive 1,000 - 2,000 mm of precipitation per year.The average temperature, $27^0$ C, is relatively uniform and is influenced by the relative proximity to the sea and by the regularity and seasonality of the rainfall. The average annual humidity is 75 % approximately.

Physiographically, Thailand can be roughly divided into four regions, namely Central; Northern; Northeastern; and Southern Peninsular Regions. Locally, Chumphon Province locates in Southern Peninsular region of Thailand *(Figure 1)*.

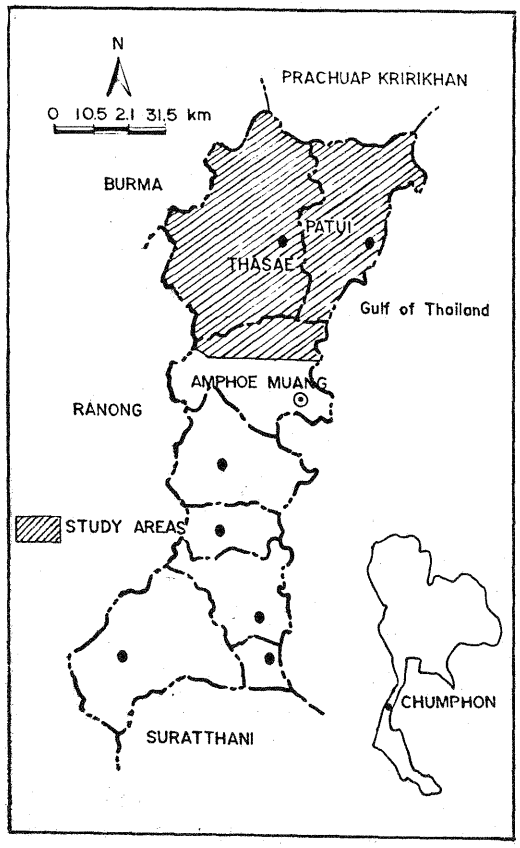
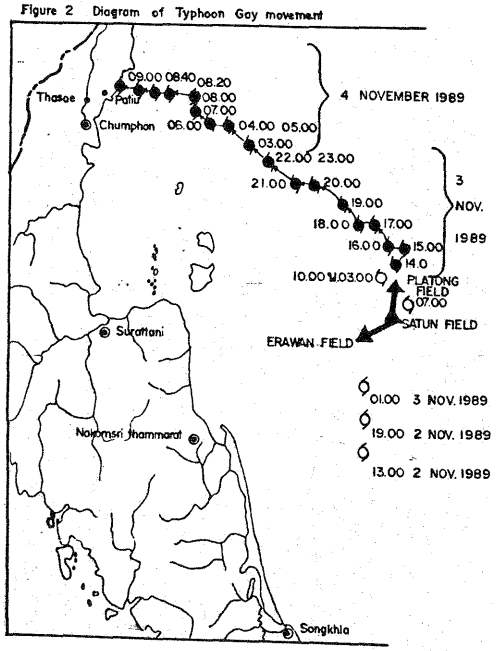



Figure 1. Map of Thailand and location of Chumphon Province.

The Typhoon 'Gay' was developed from an active low Pressure cell, which originated on the outer part of the Gulf of Thailand on 31 October and moved NW - ward almost parallel to the Eastern coast of Southern Thailand into the mid-Gulf of Thailand. It was reported that the height of sea waves were more than 10 m with wind velocity of more than 120 km/hr. It hit Pathiu District with the wind velocity of about 30 km/hr on 4 November 1989 *(Figure 2)*.

Figure 2 Diagram of Typhoon Gay movement




This tremendous typhoon caused heavy flooding and landslide which claimed several hundred lives, devastated property and damaged large agricultural areas. On the mountainous land, large areas of rubber plantation and trees were uprooted and destroyed by landslides. On the plain below, many agricultural settlements were totally overwhelmed by flash flooding and were buried underneath sandy sediment and mud. The disaster paralyzed the social and agricultural activities in the affected areas. The estimated cost of damage was about US$ 268 million.

In order to regain the normal life of the people living in this area, the Royal Thai Government immediately established a Central Committee for rapid rehabilitation of flood - affected areas. The Land Use Planning Division, Land Development Department under Ministry of Agriculture and Cooperatives, was commissioned to formulate proper land use plans to renew the damaged resources particularly the agricultural areas.

## Objectives

1. To assess the degree of damaged by Typhoon 'Gay'.
2. To identify the areas damaged by Typhoon 'Gay'.
3. To potentially formulate the appropriate land use plans.

## Study Areas

Peninsular Thailand consists of 14 provinces covering an area of about 70,715 $km^2$ or 14% of the country area. About 40% of this region is hilly and mountainous land. The peninsular experiences higher temperatures and heavier rainfall frequentially than the other regions during the Northeast Monsoon.

The areas damaged by Typhoon 'Gay' disaster were about 250,675 ha located within 3 Districts of Chumphon Province, namely : Thasae; Pathiu District and the upper part of Muang District. It located at $10^0$ 30' 00" to $11^0$ 1' 53" N latitudinally and $98^0$ 53' 31" to $99^0$ 31' 19" longitudinally with adjacent to other areas as following :

| | |
|---|---|
| **North** | adjacent to the Republic of Burma and Prachuap Khirikhan Province. |
| **South** | Muang District. |
| **East** | the Gulf of Thailand. |
| **West** | having common boundary with Republic of Burma; and Ranong Province. |

## Methodology

The methodology of this study includes visual interpretation of Landsat TM and SPOT imagery followed by stereoscopic interpretation of aerial photos, computer manipulation, and incorporation of groundtruthing information and socio - economic survey.

Remotely sensed techniques have been used as an aid for land use survey in Thailand since 1970s. According to radiometric and geometric properties related to the physical; biological and land use parameters, an original image of this study was interpreted,considering the spectral and spatial aspects of that image. Visual interpretation of the images was taken by using the most important diagnostic characteristics, including shape; size; tone /color; texture; contrast and pattern. The existing land use of Chumphon Province in 1979 and the map of coconut plantation in 1986 were closely taken into consideration during interpretation. The interpreted details were transferred to the Base maps. They were subsequently verified and confirmed during groundtruthing.

Stereoscopic interpretation of black and white aerial photos was done parallelly using topographic maps as referenced maps. These were also verified and updated during field survey. The incorporation of updated groundtruth data into socio - economic data was done possibly.The damaged areas were identified and then estimated areas were measured by using dot - grid counting.

Geographically, the current damaged maps were manually overlaid with soil map; soil potential and suitability map; maps of water resource, forest resource, climatic factor; and socio - economic constrains to formulate the potential land use plans as maps.

**Data Used**

The remotely sensed data and other maps used in land use survey, groundtruthing and in formulating alternative land use plans are as following :

1. Topographic maps at a scale of 1 : 50,000 prepared by The Royal Thai Survey Department (RTSD) :
   Map Sheet No. 4830 I, II, III, IV
   Map Sheet No. 4831 II, III
   Map Sheet No. 4730 I, II
   Map Sheet No. 4729 I, IV
   Map Sheet No. 4829 IV
2. Topographic maps at a scale of 1 : 250,000 prepared by RTSD
3. Aerial Photos at a scale of 1 : 15,000 taken before the typhoon 'Gay' disaster
4. A SPOT imagery acquired in October 1989 at a scale of 1 : 50,000
5. Landsat TM (Thematic Mapper) at a scale of 1 : 250,000 taken in July 1989
6. Aerial Photos at a scale of 1 : 15,000 taken immediately after the typhoon 'Gay' disaster
7. Land Use Map of Chumphon Province at a scale of 1:100,000 in 1979 prepared by The Division of Soil Classification, Land Development Department
8. Suitability Map of Coconut Plantation in 1986 of Chumphon Province at a scale of 1: 50,000 prepared by The Division of Soil Classification, Land Development Department
9. Report on Soil Suitability for economic crops in affected areas: Muang District, Thasae District and Pathiu District Chumphon Province prepared by The Division of Soil Survey and Classification, Land Development Department (Technical Paper no. 122 : December 1989)

**Results and Discussion**

The results of using remote sensing techniques as an aid in the assessment of natural disaster clearly showed the total devastated areas caused by Typhoon Gay.

The areas were about 250,675 ha covering 3 Districts of Chumphon Province as shown in Figure 1.

The criteria used in this assessment can be categorized by the degree of damage as follows :

1. Severely damaged area was the areas of more than 70 % devastation.

2. Moderately damaged area was the areas of 30 % - 70 % devastation.

3. Slightly damaged area was the areas of less than 30 % devastation.

Within this criteria, the existing land use with can be identified as shown in Table 1.

| Land Use Type | Areas of Damaged(ha) | | | |
|---|---|---|---|---|
| | Severely | Moderately | Slightly | Total |
| **Agriculture-Monocrop** | | | | |
| Upland crop | | | | 4,545 |
| Coconut | 17,271 | 2,244 | 1,059 | 20,574 |
| Coffee | 2,210 | 12,458 | 903 | 15,171 |
| Oil palm | 3,767 | 4,353 | 9,314 | 17,434 |
| Para rubber | 21,996 | 2,579 | 18,404 | 42,980 |
| Orchard & Trees | 136 | 62 | 294 | 492 |
| **Agriculture-Mixed crops** | | | | |
| Mixed Orchards | 10,780 | 1,871 | 3,387 | 16,039 |
| Coconut & Coffee | 2,860 | 760 | 772 | 4,343 |
| Coconut & Trees/Orch. | 450 | | 5 | 455 |
| Paddy field | | | | 10,394 |
| Forestland | | | | 87,636 |
| Peatland | | | | 3,771 |
| Villages & Buildings | | | | 605 |
| Unidentified areas | | | | |
| Improved pasture | | | | |
| Wasteland | | | | 363 |
| Water resources | | | | 25,437 |
| | | | | 436 |
| | **Total** | | | **250,675** |

Table 1 : Land use type and devasted areas identification

From Table 1., there was only 10 % of total areas, 250,675 ha, having the unidentified areas due to the less importance economically. There was about 34 % having general assessment with no-identified the degree of damage. Whereas there was about 47 % having the clear assessment of severely, moderately and slightly damages in the percentage of 23.71, 9.70, and 13.43 of the total area respectively. These figures warned planners to make decision on particular use of land and management carefully. Consideringly, on the basis of land damaged by the disaster and the properties of soils/lands themselves - this devastation can be renewed by making the zonation of improvement and rehabilitation to be implemented as described below :

1. **Severely damaged area** was assigned to be 'development zone' in which it needs a good plan to manage and develop the renewable resources sustainably. More importantly, land should be totally reformed prior to implementing the appropriate land use plans.
2. **Moderately damaged area** was assigned to be 'rehabilitated zone'. Some of the lands will be reclaimed to as it used to be while some will be remanaged and developed to regain its normal effectively.

3. **Slightly damaged area** was assigned to be 'improvement zone'. This area will be easily managed to increase the productivity of land.

4. **The rest of those identified areas** can be developed and managed in terms of tourism, industrialization, animal husbandry and etc.

However, the urgent need is to develop the agricultural land to be used productively and conservatively in order to regain their normal life as well as to prevent the possible natural disaster in the future. Socio - economic survey was then incorporated with the physical plans to formulate the feasible land use plans.

## Conclusion

The combination of remotely sensed data with groundtruthing information provided most of the best ways to assess the devastation caused by Typhoon Gay, then, to identify the areas and to do mapping on the topographic maps. This in turn allows quick and good sources of

information to be used in making the damaged agricultural areas renewably and productively.

In addition, Decision makers will have the good and right information in time while they need it. Hence the reliable and sensible decision on development activities, budget allocation, working schedule and etc. could be made by the decision makers with high confidence. This will be the great benefit to people, The Royal Thai Government and the nation finally.

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