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SR. NO. 9620

THAILAND NATIONAL PROGRAMME

OF THE

EARTH RESOURCES TECHNOLOGY SATELLITE

Pradisth Cheosakul

Secretary-General

National Research Council

Bangkok 9, Thailand

April 1973

Type II Report for Period November 1972 - January 1973

National Research Council

196 Phahonyothin Road, Bangkhen

Bangkok 9

Thailand

Goddard Space Flight Center

Greenbelt,

Maryland 20171

U.S.A.

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12. National Research Council 196 Phahonyothin Road, Bangkhen Bangkok 9, Thailand		13. Multidisciplinary Resources Surveys, National
14. Prepared in cooperation with: Applied Scientific Research Corporation of Thailand, Department of Agriculture, Royal Forestry Department, Land Development, Department of Fisheries, and Department of Mineral Resources		
15. This report briefly describes activities during a three month period, including an intensive training course in remote sensing technology and primary research efforts in several disciplines (Agriculture, Forestry, Land Use, Geology, and Oceanography). Useful applications of ERTS imagery, and several features seen for the first time, are discussed.		

Table of Contents

PREFACE

1. Objectives

The overall objective of the Government is to evaluate the extent to which ERTS data can be beneficially applied in various sectors of the economy to assist in the difficult task of acquiring data needed for resources inventory, planning, and management at the national level. Participating Government Departments have defined objectives specific to their areas of responsibility that will contribute to evaluation of applicability in the various disciplines of importance.

2. Scope of Activity

Prior to the end of January 1973, when this report became due, Thai scientists participating in the ERTS National Program had not had much opportunity to become familiar with ERTS imagery or to study the techniques of multispectral image interpretation. The first ERTS images of Thailand were received in November 1972. The month of December was devoted largely to preparations for an intensive training course in remote sensing technology to be given during January and February 1973. Publication of this report was delayed by these activities and by the desire on the part of the participants to make use of the results of the training program in their research and report writing.

The six week training program, which was sponsored by USOM--Thailand and administered by the U.S. Geological Survey, office of International Geology, was taught by a team of seven U.S. experts. A two week period devoted to the fundamentals of remote sensing (Jan 4-17) was followed by four weeks of lectures, laboratory exercises, and field trips covering the disciplines of major interest to Thailand: Agriculture, Forestry, Land Use, Geology, and Hydrology/Oceanography. The course was attended by 50 Thai scientists and technicians and 22 specialists from other countries in the ECAFE region sponsored by the Mekhong Secretariat, AID, and ECAFE.

ERTS images were used in laboratory sessions and on field trips, and several scenes were examined with the aid of a four channel color simulation viewer provided by USOM.

3. Analyses, Findings, and Techniques

Findings are reported below in the areas of Agriculture, Forestry, Land Use, Geology, and Oceanography.

Under Agriculture, investigators report selection of ground control test sites and analysis of ERTS images using 9.5 inch positive transparencies and prints and false color imagery produced on the multispectral viewer/projector.

Findings in this sector include positive delineation of floating rice regions, clear distinction between irrigated and non-irrigated areas, and recongnition of orchard and horticulture crops. Some features, in addition, were identified and outlined for the first time on ERTS images. These were alluvial fans marking ancient river outlets to the sea in the northwest portion of the Central Plain and the shape and size of flood plains in the central region.

In the Forestry sector, a new forestry map covering a test area near Chiengmai in the north was constructed using ERTS MSS band 5 and 7 imagery and ground observations.

The Land Development department reports on recognition of rivers and canals, drainage patterns, roads, habitation, vegetation, salt farms, and shrimp farms.

The Applied Scientific Research Corporation reports on conventional methods of resources inventory and some advantages of ERTS imagery. Detailed examination of one ERTS frame showed almost 50% destruction of forested land in one area that was last surveyed in 1969.

The Geology Division of the Department of Mineral Resources made a rough geologic map of Thailand from ERTS images in the course of the instructional program, aided by the U.S. instructor. The map, which will be verified and improved later, is presented in this report. Many linear and circular features stood out clearly in MSS band 7 images.

The Department of Fisheries reports briefly on observations of bottom contours and water depth, sediment boundaries, and detection of effluents and aparent circular current features.

4. Conclusions

All reporting Departments conclude that ERTS data products are useful and that their usefulness will increase as more experience is gained. Soil patterns and geological features never before observed and delineated have been mapped from ERTS images. Black and white transparencies, enlarged prints, and color reconstructions reveal details of interest that require further investigation.

5. Recommendations

Continued analysis, continued acquisition of imagery, and further investigation of automatic data processing techniques are recommended. A four channel multispectral aerial camera is expected to be available in the near future, and is expected to provide important data for positive identification and spectral composition of many features discernable on the ERTS images.

ERTS-1 Type II Report

Sector: Agriculture

(By Pongpit Piyapongse)

Objectives

The main objective is to find out what we can learn from the ERTS images in agricultural investigations relating to the following:

1. To establish a crop region map for the whole country..
2. To identify various features in soil forming factors relating to the physiographic positions, because size and shape of various areas have never been figured out by ordinary aerial photography methods.
3. To establish a soil moisture regime according to the seasonal change in various part of the country.

Scope of the study

The agricultural sector selected six test sites, which represent typical agriculture regions of the country, namely the Northern Intermontane Region, Central Plain, Northeast Plateau, Southeast Coast, Central Highland, and Peninsular Region.

Methods and Procedure

The ERTS-1 images in the form of 9.5 inch positive transparencies, 9.5 inch prints, 70 mm. positive transparencies, and false color prints were used. Multispectral color viewer, light tables, hand lens, dot grids, and planimeters were used. Field checks for ground information collections simultaneously with ERTS-1 were also employed.

Results of the study

After the termination of the ERTS Remote Sensing Training Course, the agricultural sector have been conducting several series of field checking and the uses of various equipments available at ASRCT. The results obtained are as follows:

1. The boundaries of crop regions in the Central Plain are clear and the following can be obtained.

1.1 The floating rice regions in the Central Plain area near Bangkok and Ayuthaya Province were identified very accurately. The MSS band 7 together with false color prints were very useful tools in the interpretations.

1.2 Distinction between the irrigated and the non-irrigated areas are clear.

1.3 The orchard and horticulture crops areas near the Gulf of Thailand were clearly recognised in band 7 and false color prints.

2. The features which have never been identified by ordinary aerial photography were identified for the first time from ERTS-1 data. These features are the following:

2.1 The alluvial fan in the northwest portion of the Central Plain and vicinity were identified.

2.2 Shape and size of the flood plains of the central region were very clearly recognized and measured.

3. The areas of high soil moisture content or very wet areas versus dry areas according to the seasonal changes were detected. The same area in Bangkok (frame No. E-1078-03120) which appeared black in October 9 MSS band 7 imagery appeared gray in the January image. If we could obtain a neutron probe to measure soil moisture content simultaneously with ERTS-1 imageries, we could produce a soil moisture regime map of the area very accurately.

Conclusion

The MSS band 7 and false color prints have capabilities and can be promising tools for agricultural survey in Thailand, which has alternately predominant wet and dry conditions. The ERTS prints, 1:200,000 enlargements, of the visiting World Bank Survey Group, were even more useful in making crop region maps and other regional maps.

Recommendations

The continuous supply of the imageries and the complete coverage of the whole country are recommended.

Automatic data processing should be introduced to Thailand in order to have more efficient work in ERTS data analyses.

ERTS-1 Type II Report

Sector: Forestry

(Reported by Boonchana Klankamsorn)

Objectives

1. To study, by interpretation, the ERTS-1 imagery of the area, designated as "test site area".
2. To survey the area, which was cited as forested area in order to learn of the changes.

Location

During the ERTS Remote Sensing Training Course and with the advise of the expert, the forest areas situated on the Chiangmai-Hod Highway in the following districts of Chiangmai Province are selected: Chomtong, Hang Dong, Sanpatong, and Mae Rim.

Methods and Procedure

Prints of ERTS-1 image, MSS bands 5 and 7, enlarged to 1:500,000 scale, were used in conjunction with photographs taken at the test site area. Attempts were to distinguish the forest area and non-forest area by the color tone differentiation. At the start, maps were prepared with the available ground truth data. The topographic map, scale 1:250,000, and forest map, scale 1:500,000,were also used for comparisons. The field study was to check the office prepared maps. Corrections were made based upon the ERTS-1 data.

Field Check

The checking was done under the stratified sampling method by visiting every forest type. Photographs were also made for the investigated area.

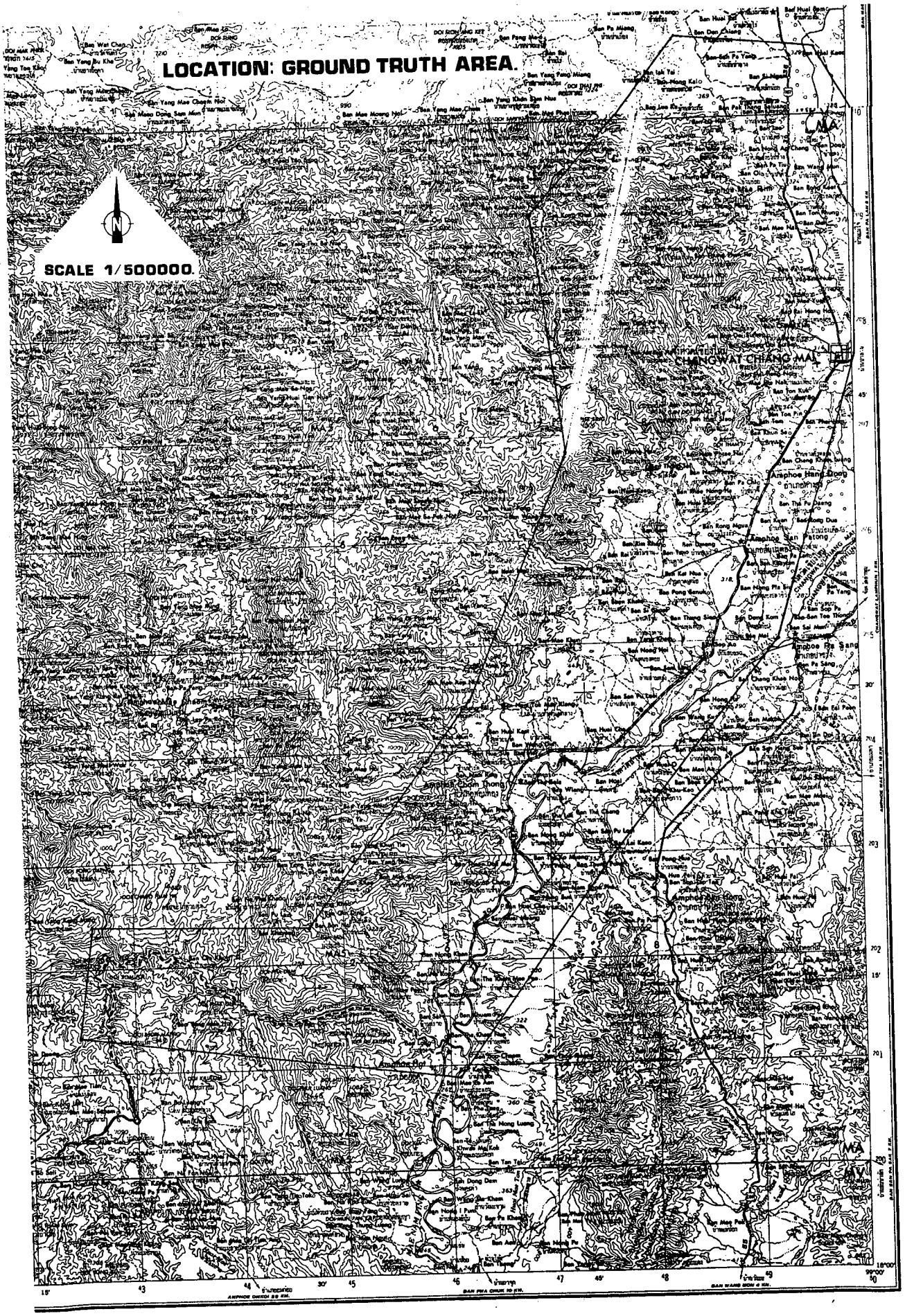
Results

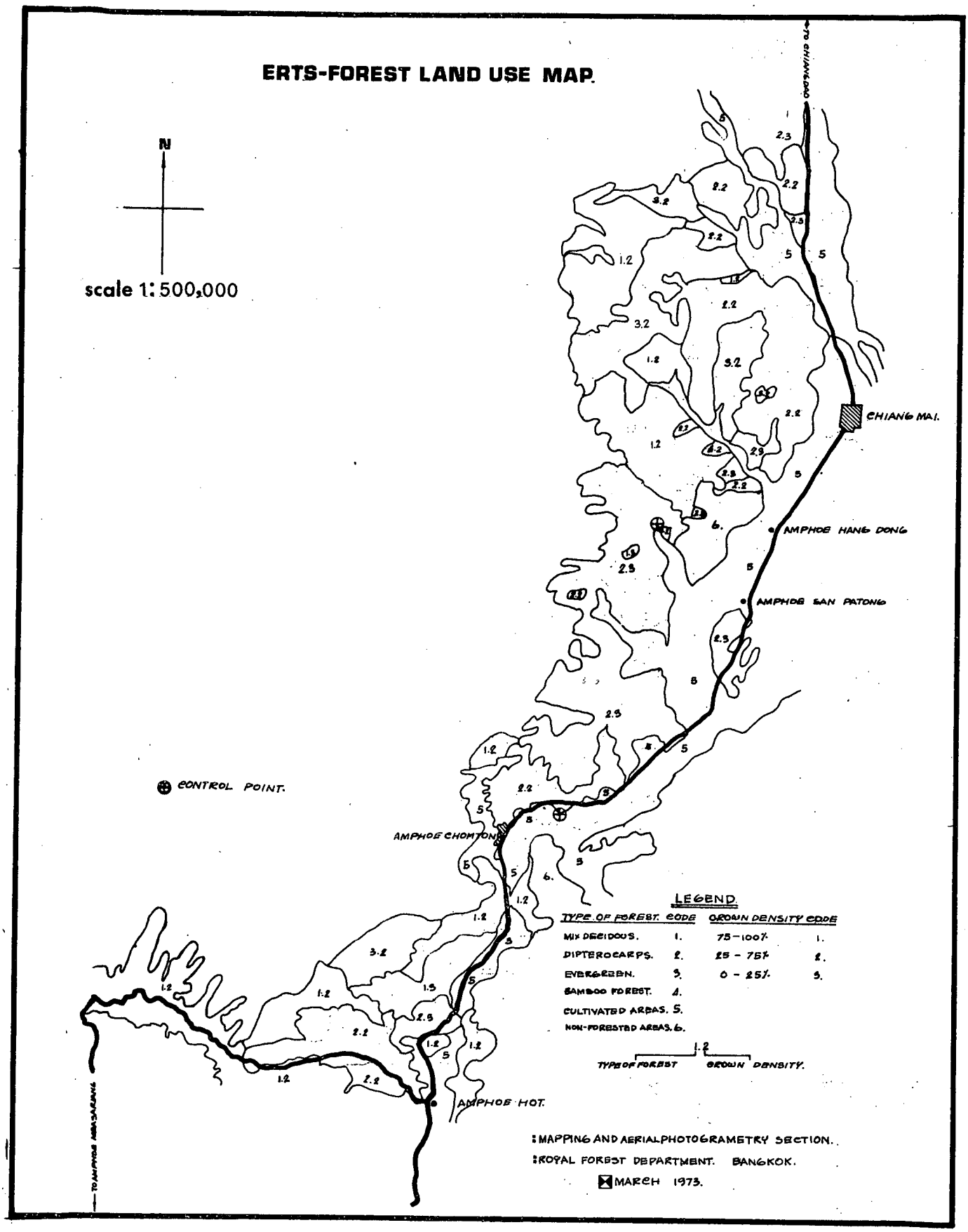
Though the task and the field works are new in the study, the result was satisfactory. Forests could then be classified broadly: forest area and non-forest area could be distinguished and mapped with the scale of 1:250,000.

Future Work

Continuing check and study will be carried out at the following test sites, each test site having the area of about 625 square kilometers:

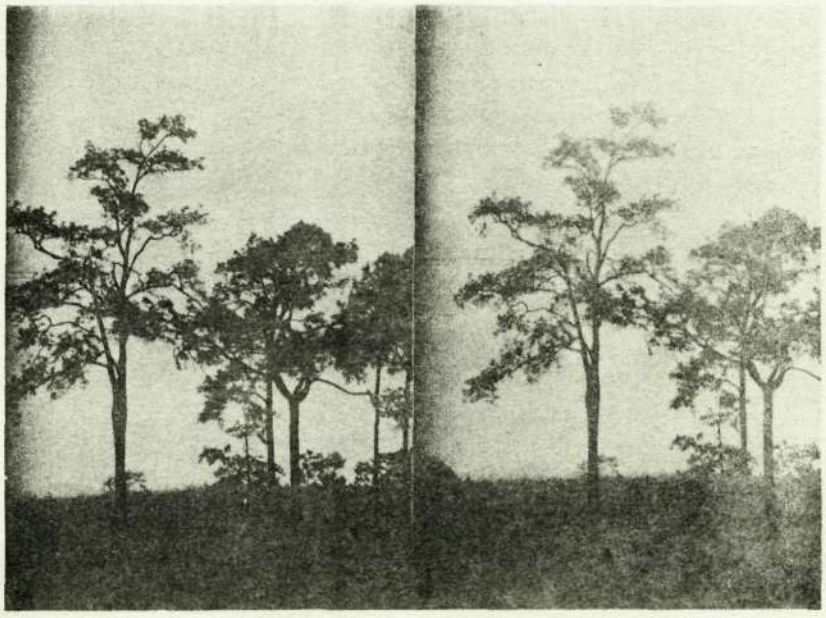
1. In the North, Chiangmai and Lampang,
2. In the Northeast, Nakorn Rajasima,
3. In the Central Plain, Kanchanaburi,
4. In the South, Ranong and Pang-nga.


LOCATION: GROUND TRUTH AREA.
SCALE 1/500000.
CHIANGWAT CHIANG MAI


ERTS-FOREST LAND USE MAP.
N
scale 1: 500,000
TO CHIANGDAO
CHIANG MAI.
AMPHOE HANG DONG
AMPHOE SAN PATONG
AMPHOE CHOM THONG
AMPHOE HOT.
CONTROL POINT.
TO AMPHOE MAESARIANG
LEGEND
TYPE OF FOREST. CODE
MIX DECIDOUS. 1.
DIPTEROCARPS. 2.
EVERGREEN. 3.
BAMBOO FOREST. 4.
CULTIVATED AREAS. 5.
NON-FORESTED AREAS. 6.
CROWN DENSITY CODE
75-100% 1.
25 - 75% 2.
0 - 25% 3.
1.2
TYPE OF FOREST
CROWN DENSITY.
: MAPPING AND AERIAL PHOTOGRAMETRY SECTION.
: ROYAL FOREST DEPARTMENT. BANGKOK.
MARCH 1973.

The following photographs taken at test sites can be appreciated more with the aid of pocket stereoscope.

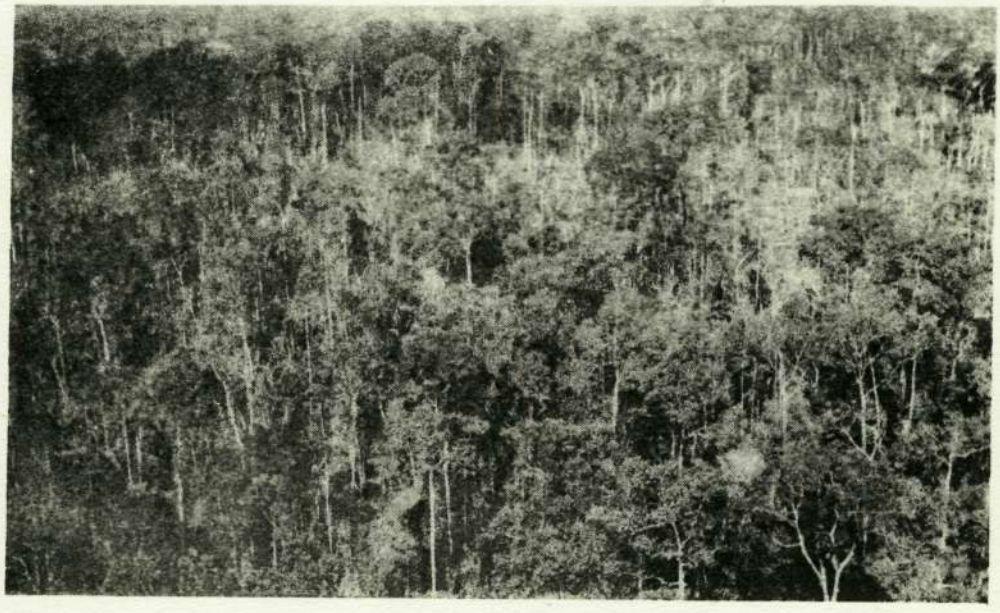
Dry Dipterocarp Forest



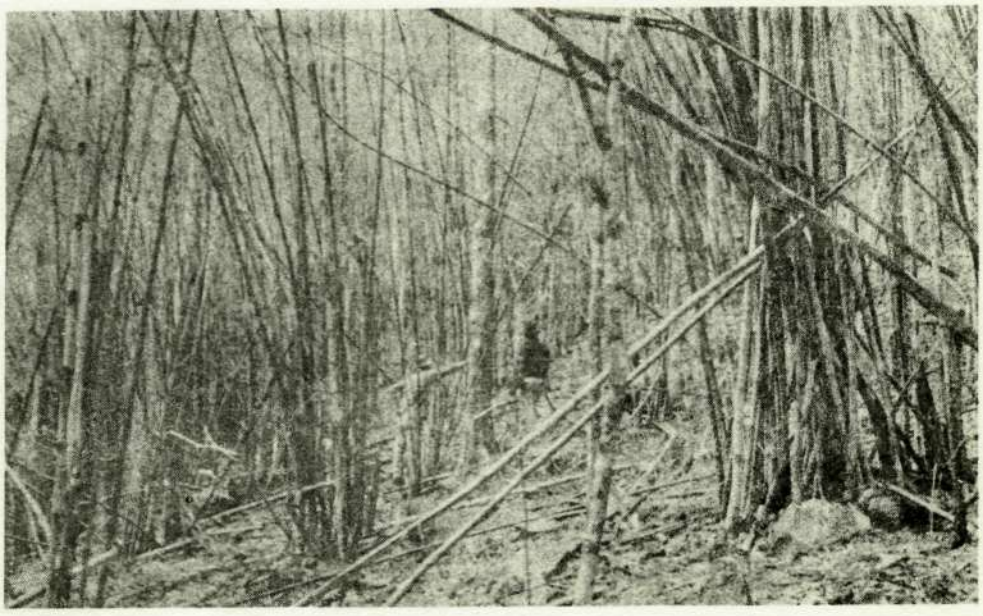
Pine Forest

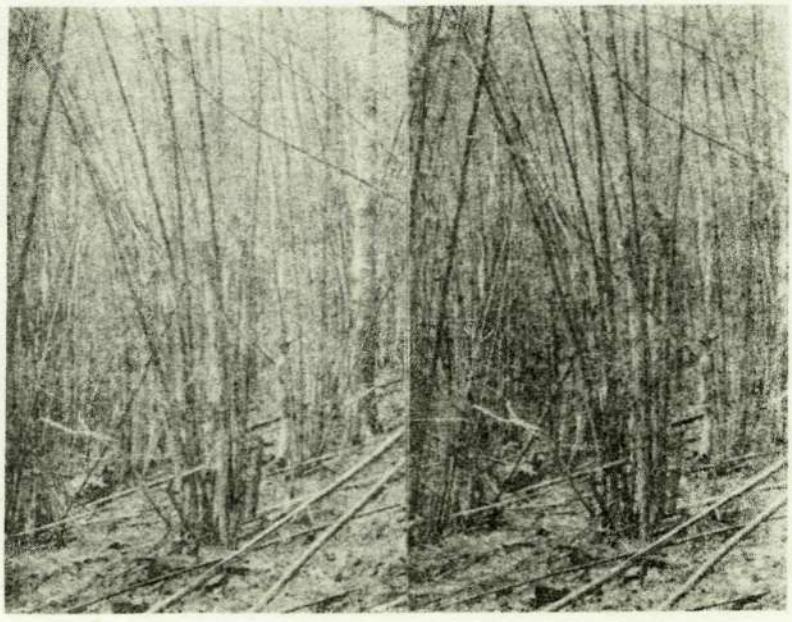
Mixed Decidous Forest

Tropical Evergreen Forest



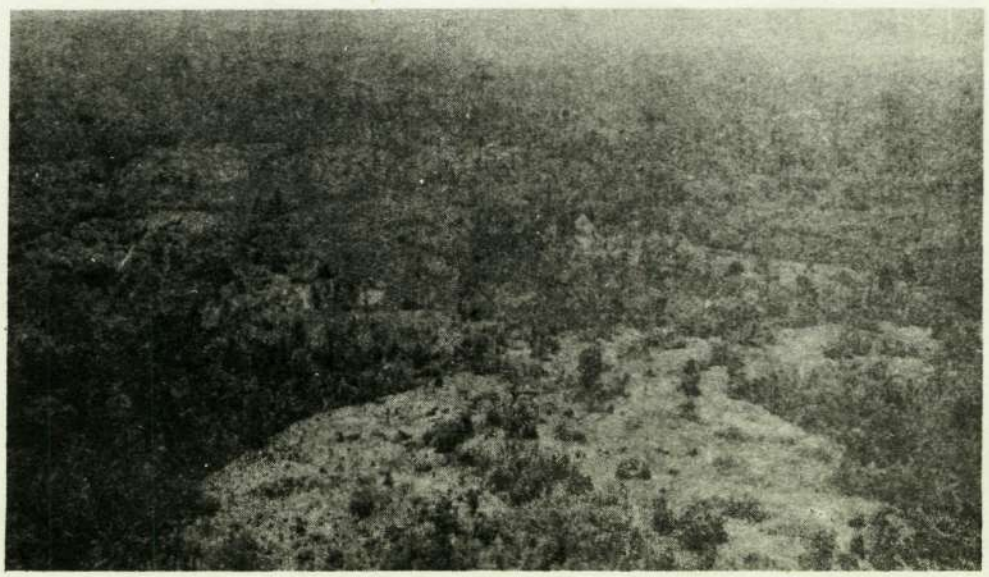
Bamboo Forest





Scrub

Shifting Cultivation



ERTS-1 Type II Report

Sector: Oceanography

(Reported by Department of Fisheries)

Study and analysis of imageries from ERTS-1 satellite indicated that certain oceanic features can be measured and mapped from space. The following article is a general resume of the studies made in the last short term intensive training programme (Jan 4, 1973-Feb 14, 1973) using ERTS-1 black and white imagery bands 4 to 7.

1. Detection can be made on:

1.1 Contour of depth can be determined by comparing the grey scale from bands 4, 5, and 6.

1.2 Boundary of sediment. The movement of sediment plume can be determined based on ground truth.

1.3 The presence of planktonic blooms and extent cannot be located from such imageries.

1.4 The effluents of the polluted water is observable.

2.1 Coastal line and contour of depth is hard to identify in the area of heavy cloud cover.

2.2 The classification of fresh water and sea water cannot be done. The area having plankton and sediment is similar, so it is very difficult to classify.

2.3 The contour line of water depth can be drawn by comparing the grey scale eventhough the same grey scale cannot show the same depth. It depends on sediment and turbidity of water.

2.4 Measurement of the water depth within the boundary contour can be measured indirectly by checking with the ground truth on sampling area.

3. There is a circular feature located in the north of Surattani coastal line that can be clearly seen on bands 6 & 7. In bands 4 & 5 clouds and water cannot be distinguished. If we look at bands 6 & 7 it can be seen to be a circular cloud, which may be caused by collision of two currents.

4. At present, it can be said that the usefulness of the ERTS-1 imagery applying to fisheries field is very small.

Comment

Because of short time of study and lack of experience in applying of the remote sensing technique to fisheries field, more time is needed for the interpreter in fisheries field to get more experience and advanced knowledge.

USE OF ERTS IMAGE IN RESOURCES INVENTORY MAPPING

SECTOR: GEOGRAPHY

(Reported by Somchit Pongpagnan)

Background: Resources Inventory has been one of the main jobs for the Ecological and Environmental Research Institute of The Applied Scientific Research Corporation of Thailand (ASRCT) since 1968. Various topics of natural and man-made resources had been mapped out onto 1:50,000, 1:250,000, 1:750,000, and 1:1,000,000 scale. Data collections were made mainly from:

(1) existing maps,
(2) Government and private publications,
(3) aerial photographs and
(4) field survey.

Some 32 topics of Nakhon Phanom and Sakon Nakhon Provinces had been shown on 1:250,000 atlas for use by the Royal Thai Government in development planning. Eastern and northern Thailand were the regions selected later for resources mapping but not in detailed as the 2 provinces.

The Resources Inventory Group plans to map the southern part resources as it's oncoming task.

Problems: The above data collection procedures are nevertheless time consuming. For Nakhon Phanom Province only, at least 2,000 prints of 9x9 inches aerial photographs had to be used. It required almost 6 months for aerial photo interpretation by one interpreter.

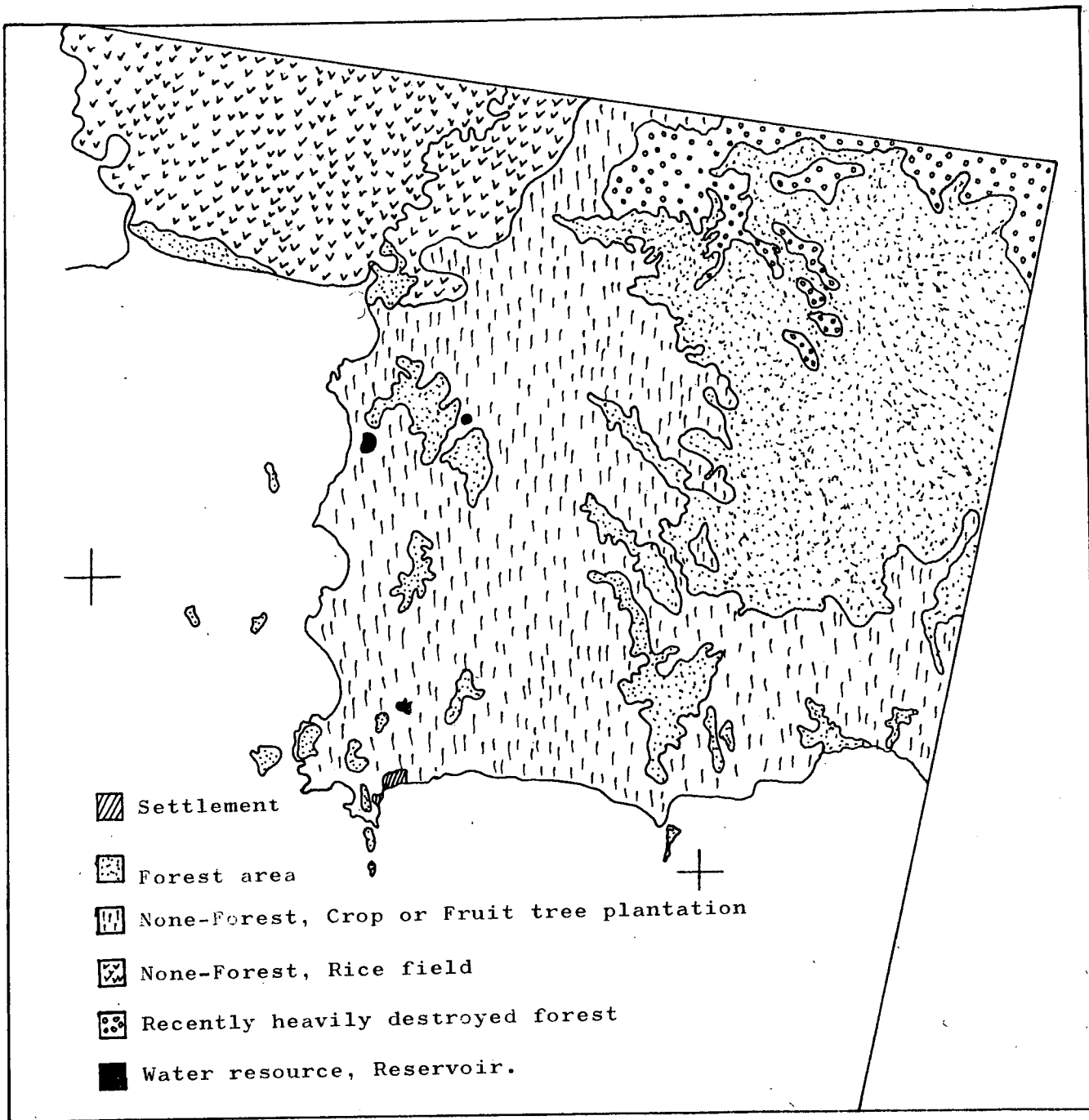
If 71 provinces of the whole kingdom have to be mapped out, one man would need 70 years to complete the task.

Besides, the resources map produced must be updated almost every year or two. This is a real problem of repeating the expensive and time consuming job.

Findings: ERTS image is found to be a useful and most advantageous source for resources mapping. The attached vegetation map when compared with an interpretation overlay made from an ERTS transparency of MSS band 6, date 6 January 1973, frame 1167-03070 shows that forest area has been reduced. Almost 50% of the forest area surveyed in 1969, largely on its perimeter, has gone.

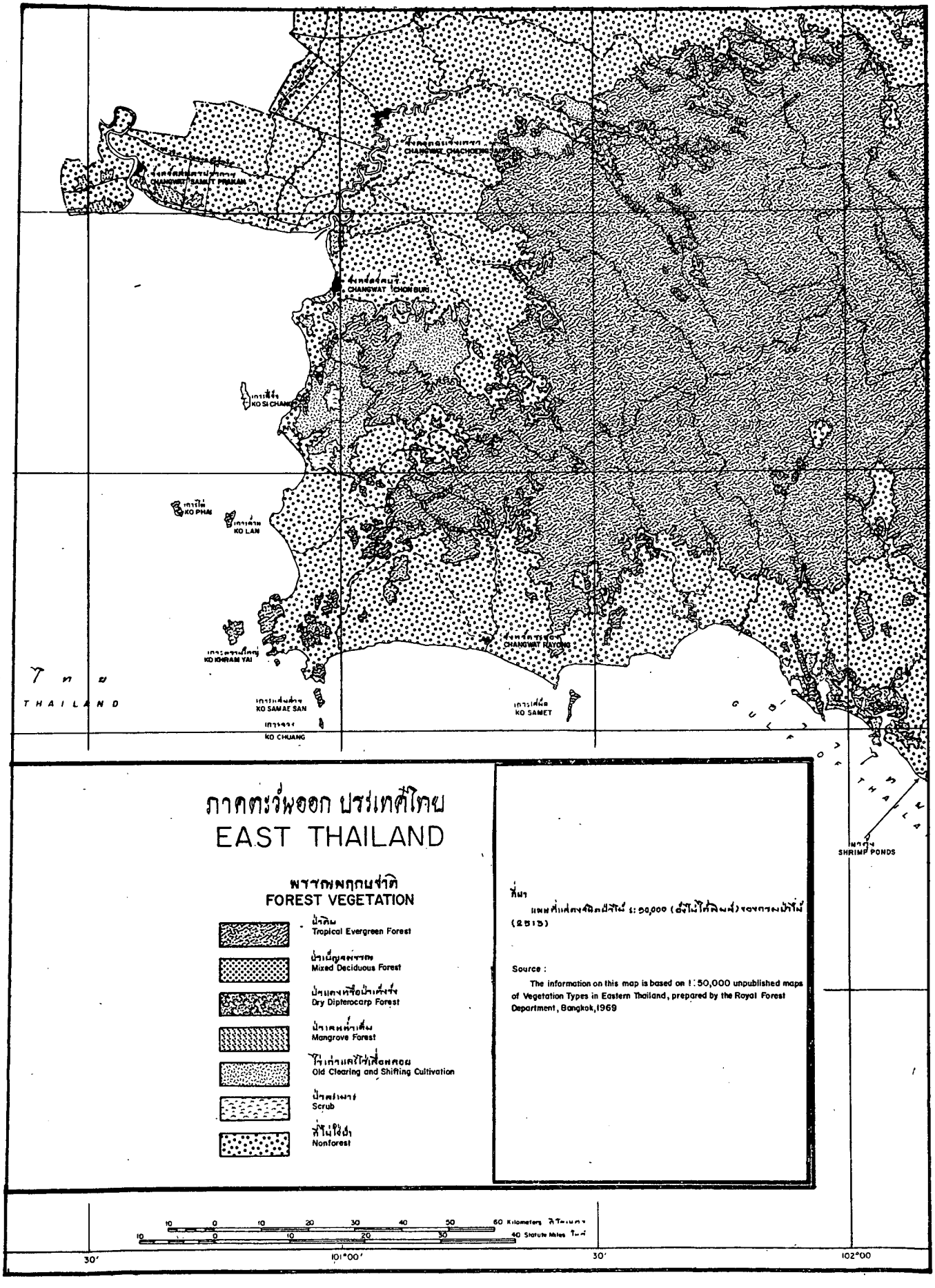
The findings were concluded as such because the mottled patches shown in the transparency hinted that the forest area would have been heavily destroyed recently.

Rice fields are slightly different from other crops because the areas of rice indicated the presence of water or moisture. The rice fields and other crop areas showed contrast.



Satellite transparency No. 1167 - 03070

MSS band 6, dated 6 January 1973


CHANGWAT SAMUT PRAKAN
CHANGWAT CHACHOENGSAO
CHANGWAT CHON BURI
KO SI CHANG
KO PHAI
KO LAN
KO KHRAM YAI
CHANGWAT RAYONG
KO SAMAE SAN
KO CHUANG
KO SAMET
SHRIMP PONDS
THAILAND
GULF OF THAILAND
ภาคตะวันออก ประเทศไทย
EAST THAILAND
พรรณพฤกษชาติ
FOREST VEGETATION
ป่าดิบ
Tropical Evergreen Forest
ป่าเบญจพรรณ
Mixed Deciduous Forest
ป่าแดงหรือป่าเต็งรัง
Dry Dipterocarp Forest
ป่าชายเลน
Mangrove Forest
ไร่เก่าและไร่เลื่อนลอย
Old Clearing and Shifting Cultivation
ป่าพรุ
Scrub
ที่ไม่ใช่ป่า
Nonforest
ที่มา
แผนที่แสดงชนิดป่าไม้ ๑:๕๐,๐๐๐ (ยังไม่ได้ตีพิมพ์) ของกรมป่าไม้ (๒๕๑๕)
Source :
The information on this map is based on 1:50,000 unpublished maps of Vegetation Types in Eastern Thailand, prepared by the Royal Forest Department, Bangkok, 1969
10 0 10 20 30 40 50 60 Kilometers
10 0 10 20 30 40 Statute Miles
30'
101°00'
30'
102°00'

ERTS-1 Type II Report

Sector: Geology

(Reported by Prayong Angsuwathana)

The objective is to carry out from the ERTS images geological investigations relating to the following:

1. Structural Map
2. Geologic Map
3. Mineralization zone Map
4. Ground Water Map

Results of the study.

After the termination of the ERTS Remote Sensing Training Course, the geology sector has been studying on 9.5 inch positive transparencies. Results obtained are as follows:

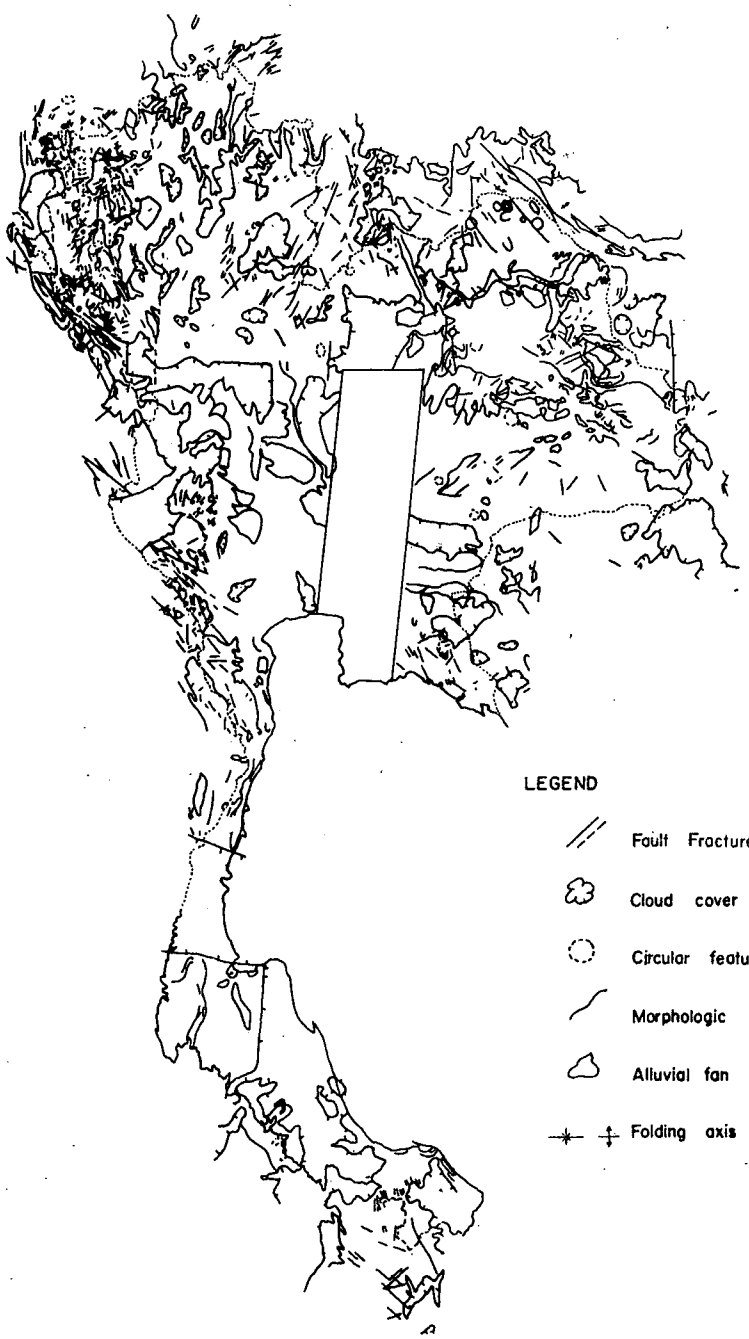
1. Detection can be done on Geomorphic features, for instance, topography rivers, soil cover, roads; on General Geology factors such as lineaments of rock formation, Circular features, faults, hard and soft rock and forest areas, bare soils, cultural features, anticlines, synclines, old channels.

2. There are limitations on identification, classification, delineation, and mensuration. Delineation can be done on large areas. Discrimination can be done in overall. Classification can be done in big formations with dominant photo characteristics, for instance limestone, granite.

3. Vast information of a large area is given in a single image, and a very careful examination can reveal various previously unknown features. For example, some of the circular features.

4. Examination of clear images, 1:1,000,000 scale, especially when taken at low sun angle, shows that geological boundaries in some places, as recorded on geological maps of Thailand, should be changed.

5. Faults and fractures can be mapped rapidly from ERTS images. The imagery is useful for mapping fissure veins possibly related to mineralization and for studies of geological history.



Approximate Scale 1 : 8,760,000

Discussion of the Geology sketch map

Following is the text of a memorandum prepared by Dr. Terry Offield* instructor in Geology, following the class exercises that produced the map shown in Fig.

This 1:1,000,000-scale map was made in approximately three days by the students enrolled in the geologic remote sensing course. Each student was assigned two ERTS-frame areas and was asked to compare the information seen in each band and at each time of coverage. Some areas had been seen by ERTS only once; other areas had been imaged two or three times. The attached index map shows the frames studied for all areas mapped. Students were asked to map structures (folds, lineaments, circular features), morphologic boundaries probably representing rock-unit contacts or outcrop areas, and tonal boundaries of possible geologic significance (such as old river channels).

The "final" map was compiled by the instructor, T.W. Offield, from overlays made by each student for all the ERTS frames. Because not all the students were familiar with photogeologic mapping, the amount of information recorded varied greatly. For areas where student mapping was particularly sketchy, the instructor partly remapped the frames to add probable structural lines. Time was not available to check carefully all the morphologic and tonal boundaries compiled - some probably are good geologic boundaries and others almost certainly are not.

This first try, a group effort, at an ERTS compilation is most encouraging. Although not even the lineaments should be taken as entirely accurate for faults or fractures (some are probably not real, others are along bedding lines, others may be cultural features, etc.), it is absolutely clear that ERTS images can be used for country-wide tectonic maps. Rapid mapping of fairly detailed character can be accomplished at scales of 1:1,000,000, 1:500,000, or 1:250,000. This work would be of great importance and merits the attention of the most competant photogeologists available. The definition of probable faults or fracture systems and circular features which may mark intrusive bodies should be invaluable in pinpointing areas for mineral exploration. This crude first ERTS map not only shows many such features, but also appears to show that Thailand has distinctively fractured tectonic provinces on a large scale, which may correlate in some way with mineralogenic provinces.

Other features excellently shown, such as domes, folds, and small basins, and old river channels, also are of potential economic importance. The former, well displayed in the Korat Plateau may be of interest for detailed surveys in petroleum exploration. The latter may be useful in defining areas for search of placer deposits or groundwater.

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* Dr Terry Offield was one of the instructors for the Thailand National Program of ERTS, Remote Sensing Training Course, held in Thailand during the period January-February 1973.
His present address is: U.S. Geological Survey
Bldg25, Federal Center
Denver, Colorado 80225

It is suggested that ERTS images be enlarged to a scale of 1:500,000 for the first detailed photogeologic study. The 70-mm positives should be used in the color - combining viewer at ASRCT in order to gain enhancement of various boundaries of geologic interest. All mapping should be checked by reference to the 1:250,000 aerial photo index sheets (and in some instances against the 1:50,000 photos), so as to add all possible detail and to confirm the nature of features seen in the ERTS images.

ERTS-1 Type 11 Report

SECTOR: LAND USE

(Reported By M. Omakupt)

MSS band 5 and 7 images for the months of October and November 1972 were used. The purpose was to learn of the contrasts and to attempt correct interpretation. Field checks were also made and the geographical features in the land use map of 1:250,000 scale and those in the ERTS images were compared.

The following observations were noted.

1. Water tracts. Rivers and canals appeared dark in the MSS band 7 images and light in the MSS band 5 images. The whole course of the Chao Phraya River could be detected. Other important rivers were also noted and it was found that their courses were not similar to those mapped from aerial photographs several years ago. Irrigation feeder canals north of Bangkok could also be recognized. The flooded area of the plain appeared darkish in MSS band 7 image and could be distinquished from the adjacent area.

2. Drainage Pattern. This could be detected in both MSS band 5 & 7 but appeared distinctly on MSS Band 7 images.

3. Highways and roads. Phahonyothin Highway and main roads could not all be detected in MSS band 7 but could be seen clearly on MSS band 5 image.

4. Habitation. The provincial location could be detected, when comparing the ERTS image with the available topo-map and land use map. The inhabited site, particularly townsite of large area appeared lighter in tone than those of the adjoining locations. Big spaces such as the airfield and its buildings at Don Muang airport and the campus of the Asian Institute of Technology could be spotted readily.

5. Vegetation. The area of the alluvial Central Plain which is the main rice growing terrain appeared dark and color tonation was almost even. It was ascertained that the time of ERTS-1 overflight was the time when rice paddy was growing and had sustaining water in the field. It was concluded that where the area of intensive rice-growing had plenty of water, the tone of the image of such area was darker while the color of up-land crop-growing area appeared whitish and the shade was of fine texture. In the forested area, the texture appeared rather coarse. The tonal differences can be attributed to varieties and densities of the forest vegetation. The littoral or mangrove forests appeared dark and coarse texture.

6. Other observations. Salt pans and shrimp farms along the Gulf delta area showed shapes and sizes well. The alluvial fan of the Supanburi Province, where sugar cane and other crops were growing, needed more study.

Conclusion: ERTS-1 images helped in Land Use Survey, because changes of vegetation, water tracts, and also shore-line boundaries could be detected and mapped.

The Land Development Department, as the result of the ERTS Remote Sensing Training Course, is now preparing a proposal to the U.S. Bureau of Reclamation for the use of IR film in the land use survey. This will be complementary to the ERTS imagery study.

ERTS-1 Type II Report

Sector: Geography
(reported by ASRCT/RIG)

ERTS-1 photographs caught the interests of the Kra Canal Survey Office of a consortium (consisting of the Tippetts-Abbett-McCarthy-Stratton Engineers and Architects and the Robert R. Nathans Associates, Inc.). The Applied Scientific Research Corporation of Thailand has reproduced several copies of the photographs for their use.

The photograph in the Bangkok Post of 22 March 1973 issue is one of them. It shows one of the six proposed sites for the construction of the Kra Canal.

The Bangkok Post

An Independent Newspaper

Vol. XXVII No. 79 BANGKOK THURSDAY MARCH 22, 1973 Price 3.00 Baht

Kra canal: A down to earth view

PHOTOGRAPHS taken from an altitude of 914 kilometres give the earth-bound a bird's eye view of this area in Southern Thailand.

Appearing in the picture are Surat Thani (upper right); Pangnga and Phuket, (lower left).

The area is of special importance to surveyors choosing possible sites for the Kra Canal.

Scale of the photo is 1:1,000,000. Obtained from multispectral imagery taken from NASA's Earth Resources Technology Satellite, the photograph was taken on October 9, 1972 and defines an area of about 185 square kilometres.

It is here that one of the man's greatest undertakings in modern times may transform the economy of the area through the peaceful use of nuclear energy.

Studies on the canal are going on at the present time. A pre-feasibility survey is expected to be completed by September 1.

Such photographs from the 'eye-in-the-sky' may prove invaluable to scientists.

The satellite is capable of showing different details of the area photographed. Precise details of water reflection, turbidity, current patterns are available. Also agricultural patterns, land use and road networks are visible in the photographs.

The picture shown here details the coastline, rivers, streams, reservoirs, land use patterns, distribution of vegetation and geological features.

The 1,000 kilogramme satellite is designed to photograph the entire surface of the earth in 18-day intervals.