วารสารวนศาสตร์ปีที่ ๓ ฉบับที่ ๓
กรกฎาคม-กันยายน ๒๕๒๗
Thai Journal of Forestry

การใช้ภาพถ่ายดาวเทียมสีผสมศึกษาลักษณะการใช้ที่ดินในเขตลุ่มน้ำแม่ปิงและน่าน

FOREST LAND-USE STUDY USING LANDSAT FALSE COLOR COMPOSITE A CASE STUDY AT PING AND NAN CATCHMENT AREA

ประสงค์ สงวนธรรม
1/
PRASONG SAGUANTAM

เรื่องย่อ

การประยุกต์ใช้ภาพถ่ายจากดาวเทียมชนิดสีผสม นอกจากจำแนกพื้นที่ป่าไม้ออกจากพื้นที่เพื่อการเกษตรและแหล่งน้ำได้แล้ว ยังสามารถจำแนกแบ่งชนิดป่าไม้และความเสื่อมโทรมของป่าออกเป็นแต่ละประเภทได้โดยสังเกตจากความแตกต่างชนิดสีและวรรณของสี ไม่เพียงแต่ศึกษาเฉพาะส่วนผสมของสีบนแผ่นฟิล์ม ซึ่งได้แก่ สีเหลือง, แดง, และน้ำเงินเท่านั้นยังต้องศึกษาลักษณะทางนิเวศน์-วิทยาป่าไม้ควบคู่กันไปด้วย ดังนั้นการเลือกภาพซึ่งถ่ายทำในฤดูแล้ง จึงเป็นสิ่งจำเป็นที่ใช้แยกป่าผลัดใบ และป่าไม่ผลัดใบได้ ข้อมูลด้านอื่น เช่น แผนที่ภูมิประเทศ, แผนที่การใช้ที่ดิน, และข้อมูลจากการตรวจสอบภาคสนาม ยังได้นำมาประมวลในการแปลภาพเพื่อให้มีความถูกต้องมากขึ้น

การศึกษาครั้งนี้ใช้ภาพถ่ายจากดาวเทียมชนิดสีผสม มาตราส่วน ๑ : ๕๐๐,๐๐๐ ซึ่งถ่ายทำในเดือนเมษายน ๒๕๒๖, ธันวาคม ๒๕๒๗, และ มกราคม ๒๕๒๘ จำนวน ๔ ภาพ ครอบคลุมพื้นที่บริเวณลุ่มน้ำปิง และลุ่มน้ำน่าน ซึ่งคิดเป็นพื้นที่ ๒๔,๕๐๐ และ ๑๓,๓๕๐ ตารางกิโลเมตรตามลำดับ พบลักษณะการใช้ประโยชน์พื้นที่ป่าไม้เป็น ๓ ประเภทใหญ่ได้แก่ พื้นที่ป่าธรรมชาติ, พื้นที่เกษตรกรรม, และพื้นที่แหล่งน้ำ พื้นที่ป่าธรรมชาติสามารถจำแนกได้เป็น ๙ ชนิด ตามลักษณะพรรณไม้ที่พบ คือ ป่าสน, ป่าดิบเขาชื้น, ป่าดิบเขา, ป่าดิบแล้ง, ป่าผสมที่มีไม้สัก, ป่าเบญจพรรณ, ป่าเต็งรัง, ป่าเต็งรังผสมสน, และป่าเสื่อมโทรม

การนำเทคนิคการแปลภาพจากดาวเทียมมาใช้ประโยชน์ในการจำแนกพื้นที่ป่าไม้นับเป็นความก้าวหน้าและเป็นประโยชน์ในสาขาการป่าไม้อย่างมาก เนื่องจากสามารถจัดจำแนกชนิดป่า

1/ Junior staff in the Faculty of Forestry Kasetsar University Bangkhen, Bangkok.

ได้รวดเร็ว เป็นพื้นที่กว้างถึงระดับจังหวัด ทั้งยังเป็นการประหยัดทั้งแรงงานและรายจ่ายควบคู่กันไป

ABSTRACT

The forest land-use classification of Ping and Nan river basins was carried out using the so-called false color composite prints (FCC) of LANDSAT data. These color composite prints were composed from LANDSAT MSS taken make the excellent classification and mapping possible. Not only the forest type can be interpreted from the images, but also the coverage area of each type can be calculated from 1 : 500,000 scale images. Furthermore, the degree of disturbance of each forest type can be detected as well The accuracy of the forest classification map was increased by means of ground thruth surveying technique.

INTRODUCTION

False color composite images 1 : 500,000 scale of LANDSAT MSS were reformed and reproduced by the National Research Council in the early of 1985. The four images which cover the whole Ping and Nan river basins were recorded in April 1983, December 1984, and January 1985 and most of the images were taken in dry season.

Since the techniques of using LANDSAT data were proved to be the beneficial tools for research and study in many subjects, especially in land surveying. The color composite images provide more details than the ordinary black and white images. Thus the design of the study is to differentiate the forest type and its condition in to the reliable form of land-use map. Such data also provide the general view of the impact assessment and land-use planning accordingly.

OBJECTIVE OF THE STUDY

The objectives of the study in these two river basins are :

1. To apply LANDSAT data in order to delineate forest and non-forest area
2. To classify the forest area into different ecological type
3. To perform the basis data i.e., area, forest condition, site, stand composition, and forest type map.

Such basis data mentioned above are determined as one of the important group of data to finalize the long-term evaluation after all parameters and problems are discussed.

METHODOLOGY

A following study are concerned with interpretation and mapping techniques which the important elements of the measures designed include.

1. Preliminary work. The first step of the process was involved in planning and preparing process which are the guide line to set up piorities of the study. The preparing process was include ; acquistion of LANDSAT data from the National Research Council, preparing of interpretation aids, and gathering of related data i.e., topographic map, alnd-use map, climatic map, and etc.

2. Preliminary LANDSAT image interpretation. An interpretation technique was attempted in this study was aiming at visualization interpretation. The interpretaters should have experieance, good justment, and knowledge in remote sensing. Each false color image is comprised

Table 1. Forest land-use classification in Nam Ping basin

Type		Area	
level 1	level II	sq.km.	%
Forest land	Pine	72	0.24
	Moist hill evergreen	620	2.10
	Hill evergreen	6,828	23.15
	Dry dipterocarp with pine	828	2.81
	Dry evergreen	3,362	11.40
	Mixed deciduous with teak	4,028	13.65
	Mixed deciduous	3,452	11.70
	Dry dipterocarp	2,252	7.63
	Disturbed	2,584	8.76
	Total	24,026	81.44
Agricultural and urban lands		5,214	17.68
Reservoir		260	0.88
	Grand total	29,500	100.00

Natation : base on LANDSAT data recorded in 1983 and 1985.

variety, dense in stand density, and so high in humidity that numerous kinds of climbers, epiphytes, ferns, orchids can be found in this sub-type. The main tree family exist in composition is Facaceae which are Lithocarpus spp., Castanopsis spp., and Quercus spp. The total area of this sub-type is 620 sq.km.

3. Dry dipterocarp with pine forest. This forest type is the most severe type of pine forest which its component are full of deciduous trees that shed their leaves in dry season mixed with coniferous trees. Caused by non-fertile acid soil, the dipterocarp species and some others broad leaves trees can survived in its nature. The common evergreen species exist in this forest type are Pinus spp., but broad leaf species are Dipterocarpus tuberculatus, Dibteracarpus intricartus Shorea siamensis, Shorea obtusa, and etc. The ground floor are full of grass and Phoenix humilis in growing season but later disappeared caused by fire in dry season every year. The density is not so dense as in pure pine stand and 2-layers of trees are found in this forest type. The total area of dry dipterocarp with pine forest is 828 sq.km.

4. Hill evergreen forest. The hill evergreen forest covers an area of about 6,828 sq.km. or the largest area in the basin where the elevation is more than 1,100 m above mean sea level. It is composed of more than 2,000 species, the richest in tree species than moist type. Not only tree species in family Fagaceae are the most abundant but also found in family Dipterocarpeceae, Anacardiaceae, Leguminosea, Rubiacea, and Ixonanthaceae such as Dipterocarpus spp., Hopea spp., Irvingia malayana, Melanorrhoca spp. Slrychnos nux-vomica, Terminalia spp., Albizia

7. Mixed deciduous forest. The mixed deciduous forest comprises of 3 stories that majary tree species are Plerocarpus macrocarpus Mangifera spp., Dalbergia spp., Terminalia spp., Diospyros spp., Xylia kerrii, Careya arborea, Sindora siamensis, Cassia spp., Spondias spp., and etc. The mixed deciduous forest occupies the shallow soil or along the ridgeincluded the area about 3,452 sq.km. On the ground layer, there is a luxuriant growth of grass, herbs, and small shrubs but they are destroyed by fire in dry season. The ground layer species are ; Eupatarium ordoratum, Imperata cylindrica, Apluda mutica, and etc.

8. Dry dipterocarp forest. This forest type is commonly found at the summil of hill where the rock exposed to surface soil, and also found in lower clevation where the soil is lateritic or rocky type. The total area of this forest type is 2,252 sq.km. The composition of this forest type is low in density. Most of the trees in composition shed their leaves and rest at dormant stage during dry season. All grass, shrubs and herbs are disappeared in dry period. The important tree species are Dipterocarpus spp., Shorea obtusa, Shorea siamensis, Canarium kerrii, Morinda arborea, Phyllanthus emblica, Vitex peduncularis, Grewia sp., and etc. The ground layer is mainly composed of grass and cycad.

9. Disturbed forest. The disturbed forest in this study implies the area which was intertered by man. Thus, it includes area of shifting clutivation, bush fallow, and old clearing. In Nam Ping river basin especially the upper part was destroyed by hill tribe men to practise shifting cultivation. Numrous of forest area was cut down and burnt by the cultivators. Some trees were left and some pioneer species succeeded in the area. It can be deemed as the most extreme form of

ordoratissima, Anthocephalus chinensis, and Ficus spp.

Because of its densed crown canopy and high moisture content, so that it's suit for water supply source and protecting the environment so far.

5. Dry evergreen forest. The dry evergreen forest is mostly occupied the dry area of the lower part of hill evergreen forest and the elevation is not exceed 1,100 m above sea level. This forest type covers an area of 3,362 sq.km. It's still rich in species and forest fl floor is dense in small shrubs, climbers, and grass. The vertical structure is composed of 3 layers. The most abundant species in the composition are Hopea ferrea, Amoora polystachya, Irvingia malayana, Terminalia bellerica, Ficus alatissima, Mangifera caloneura, and etc. The undisturbed dry evergreen forest also play the important role in term of protection forest.

6. Mixed deciduous forest with teak. The mixed deciduous forest accupies the lower part of Nam Ping basin around the reservoir. It is composed of 3 structural layers which tree height is about 15-25 m. Almost of broad leaf species shed their leaves in summer and forest fire frequently occure in this dry period of the year. Generally, this forest type is found on sites having an annual rainfall of less than 1,500 mm, and associated with six month dry period. The dominant tree species are Tectona grandis, Xylia kerrii , Lagerstroemia calyculata, Pterocarpus macrocarpus, Afzelia wylocarpa, Sindora siamensis, Vitex pinnata, Dalbergia spp., and etc. Bamboo and shrubs are the most aboundant in ground floor expecially during growing season. The total area of this type is 4,028 sq.km.

forest area. The total disturbed forest are in the basin is 2,584 sq.km, where it was fertile land in the past. Almost of the disturbed forest has few trees left and full of grasses and herbs which are non-valuable weeds and may easily caused the forest fire in dry season. This status is undersirable in watershed management and protection forest aspect, that is the dangerous situation for adverse affect suchas flooding in lower basin and caused drought in dry season.

FOREST LAND-USE CLASSIFICATION IN NAM NAN BASIN

Nam Nan river basin covers an area of 13,350 sq.km. situated the whole northeastern part of northern Thailand. This catchment area was influenced by eastward monsoon, that effects the vegetation to become humid tropic type. Then the vast area is covered by luxuriant forest which can be classified into 5 forest types ; hill evergreen, dry evergreen, mixed deciduous, dry dipterocarp, and disturbed forest (Table 2).

1. Hill evergreen forest. Along the border or western part of the Nan basin, where the elevation is between 1,500 - 2,000 m above mean sea level and the annual rain fall is between 1,000 - 2,000 mm, 2,330 sq.km. of hill evergreen forest scattery occupies all over the area. Many of them were eneroached by local people who seeked for cultivated land for years. The forest is composed of 4 stories with thick and dense undergrowth. The dominant layer comprises of numbers of the oaks and chestnus. The humidity is so high that masses, fems, and climbers are abundant in the forest. Along the valleys and riverside are luxuriant and rich in species, where as the summits and ridges occure slightly poor condition. Stand composition of this forest type are Schima wallichii,

Cinnamomum spp. Podocarpus imbricatus, Betula alonoides, Quercus spp., Lithocarpus spp., Catanopsis spp., Rhododendron spp., Symphocos spp., and Albizia ordoratissima.

Table 2. Forest land-use classification in Nam Nan basin*

Land-use type level I	Land-use type level II	Area sq.km	Area %
Forest land	Hill evergreen	2,330	17.51
	Dry evergreen	3,746	28.06
	Mixed deciduous	477	3.58
	Dry dipterocarp	230	1.72
	Disturbed	4,275	32.02
	Total	11,066	82.89
Agricultural and urban lands		2,024	15.16
Reservoir		260	1.95
	Grand Total	13,350	100.00

Notation : *based on LANDSAT data taken in 1984.

2. Dry evergreen forest. This type of forest is scattered all over the basin, even along the hill ranges of about 700 m above mean sea level. Th annual precipitation is between 1,000-2,000 mm. It covers the largest area in Nam Nan river basin of 3,746 sq.km. Unfortunately, the dry evergreen forest accupies the low land or hill where the transportation net work passed into the site, then numbers of valuable or commer-

cial trees were illegal harvested by man for years. That's mean the forest area along Nan river basin had been changed at rapid rate each year. Trees species exist in the area are Hopea ordorata, Alstonia scholaris, Anisoptera oblonga, Tetrameles nudiflora, Afzelia xylocarpa, Lagerstroemia ovalifolia, Castanopsis spp. Lithocarpus spp., Spondias pinnata, Terminaria bellerica, Irvingia malayana, Toona ciliata, Dipterocarpus turbinatus, Cleidion javanicum, Pterocymbium javanicum, and etc. The undergrowth is dense and composed of mosses and lichens which sometimes disappear in dry season.

3. Mixed deciduous forest. The deciduous formalions are caused by dry preriod of more than six months, the precipitation is low, and the climate is more seasonal. Vegetation in the regions shed their leaves during dry season. The height of predominant trees is comparatively lower (20-25 m) than that of evergreen forest (25-35 m). The forest ground fire occurs freguently during dry period of the year. This type of forest occupies between the elevation of 500-600 m above mean sea level. The composition of tree species are almost deciduous species such as Tectona grandis, Pterocarpus macrocarpus, Careya arborea, Irvingia malayama, Terminalia spp., Xylia kerrii, Bombax insigne, Dalbergia cultrata, D. diveri, Gmelina arborea, Albizia lucida, Lagerstroemia speciosa, Diospyros mollis, Vitex peduncularis, Afzelia xylocarpa, Aphanamixis polystachya, Schleichera oleosa, Garuga pinnata, Cratoxylum spp., Stereospermum spp., Cananga sp., and etc. The ground flora is varied and mainly composed of grasses, herbs and seedlings. Evidence from the classification shows that mixed deciduous forest covers an area of 477 sq.km.

4. Dry dipterocarp forest. Dry deciduous dipterocarp forest occupied along the ridges at the elevation of 200-500 m altitude. The stand density is changed into more open stand, due to soil depth, forest fire, soil nutrient, climate for examples. Then vertical structure can be considered as two stories. The predominant species belong to the family Dipterocarpaceae. Tree species found in this type are Dipterocarpus obtusifolius, D. tuberculatus, Shorea obtusa, S. siamensis, Quercus kerrii, Careya arborea, Cratoxylum formosum, Dalbergia cana, Pterocarpus macrocarpus, Croton oblongifolius, and etc. The ground flora becomes to tuber, rootstock species or annual plants such as cycad, bamboos, and grasses. However, Nan river basin has a high everage precipitation so that this type of forest covers a small area of about 230 sq.km. only.

5. Disturbed forest. The disturbed forest implies the most extreme form of forest type. The term disturbed forest are include, all deteriolated forest types which are hill evergreen, dry evergreen, mixed deciduous, and dry dipterocarp forests. Almost of forest characteristics had been destroyed by man, so that very few big trees are left, undesirable species (grasses, herbs, and shrubs) succeeded instead of valuable species, the soils are erodible and non-fetile soils. There are three patterns of forest destruction in Nan river basin ;

:- the first is due to shifting cultivation practise by hill tribe men who live along the border and highland of Nan province

:- the second caused by the land hunger who expand the coltivated area to raise up the crop production

:- the last problem is concerned about the illegal cutting of valuable commercial species.

The first and second patterns are the severe problems which cause the great loss of forest area where the last pattern still left some non-valuable trees inside the forest area. The study shows the great number of 4,275 sq.km. of forest were deteriolated and changed into disturbed forest.

RECOMMENDATION

1. Finding shows that the feasibiligy of forest type classification using LANDSAT 1 : 500,000 false color composite is possible, particulary in regional level.

2. For Thailand itself, about 40 scenes of LANDSAT images cover the whole Thailand. That means about 64,000 baht (or 2,370 us. dollar) were used to purchase the false color composite.

3. In the other hands, the fixed cost per unit area is about 0.04 baht/square kilometer only. (an instrument and man power are not included)

4. The accuracy of an interpretation mainly depends on knowledge, background, experieance, and numbers of ground data collection.

5. To increase the accuracy of area measurement, the scale rectification of each image should be determined by using sophiticated interpretation instrument.

6. Change detections of land-use types using multi-date images are helpful in term of phenological changes of plant covers.