

Study of Plant Biodiversity and Density mapping using Geoinformatics

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ABSTRACT

The important of plant species diversity with the rich ecosystem to maintain the balance of the species. The objectives of this research 1)to classification the forest type using the satellite imagery. 2) to study the plant biodiversity of tree with measurements from the sampling plot using the importance value index (IVI) in the KhokKaow national forest. 3) to determine the plant density map of relative density (RD) using the geographic information system. The results of the forest type classified found that the closed deciduous forest showed the most of high density or high vegetation was the central region of the study area. The results of the IVI value found that the rank of three highest value was *Xyliaxylocarpa* (34.02), *EllipanthustomentosusKurz* (28.41), and *Dipterocarpus tuberculatusRoxb.* (23.9), respectively. The three lowest value of IVI was *CareyaarboreaRoxb.* (0.21), *Phyllanthus emblica L.* (0.22), and *Diospyros ebenum* (0.22), respectively. The results of plant density map found that high plant density found that the west and south region of the KhokKaow national forest.

Keywords—plant species diversity; vegetation index; spatial interpolate;

I. INTRODUCTION

In Thailand, the area of forest cover at 163,974.51 sq.km. in 2018-2019 or roughly 31.68% of total land area divided into forest area in the central region as 19,574.10 sq.km., northeastern region as 25,148.87 sq.km., eastern region as 7,559.27 sq.km., western region as 32,196.76 sq.km., southern region as 17,955.16 sq.km., and the northern region as 61,331.38 sq.km., respectively [1]. The northeastern Thailand located on the Khorat Plateau, bordered by the Mekong River (along the border with Laos) to the north and east, by Cambodia to the southeast and the Sankamphaeng Range south of Nakhon Ratchasima [2]. MahaSarakhm province is located in the northeastern region of Thailand. The province is mostly a plain covered with rice fields. The total forest area is 213.76 sq.km. or 3.8 percent of provincial area [1]. KhokKaow national forest is the habitat and nurture of many kinds of animals both inside and outside the forest. KhokKaow national forest is the source of water, a rich source of food, source for learning and researching of natural, an eco-tourist attraction and a source of the local herbs [3]. An area of the KhokKaow national forest, MahaSarakhm Province, with a total area of 8.62 sq.km.

The definition of species diversity is the number of species and the abundance of each species that live in a specific place. The number of species living in a place is called species richness. The important of species diversity in a complete ecosystem, a diverse and balanced number of species exist to maintain the balance of ecosystem. The relationship of an ecosystem, all the species depend on directly or indirectly. More productive and sustainable ecosystem, it is important to keeping high species diversity. The species diversity varies according to different geographical location with tropics having highest and declines as we move towards poles. Most species of rich environments include tropical rainforests, coral reefs and ocean bottom zone. Each species plays an important role in the ecosystem. Conservation of diversity is important because once it's extinct, we can't get it back.

Presently, the technique for instrumental in the assessment biodiversity to analyze landscape patterns and spatial relationships between the biodiversity called the geoinformatics technology. Satellite imagery is on of most technique for the classification of land used or land cover (LU/LC) to classify for represent the LU/LC in the study area. Usually, the classify form satellite image uses the multi-spectral images to classification of LU/LC. The normalized difference vegetation index (NDVI) is one of vegetation index with a calculated for the multi-spectral image between the Red band and the Near infrared band. The NDVI index can be representing parameter for identifying vegetation [4] and the NDVI values used for classify the different of land cover type in the study area [5]. In this paper, presented the classify of land cover of the forests type using NDVI index from the satellite image and using field surveying for data collection of the plant biodiversity. Furthermore, the estimating of density mapping of plant biodiversity using the geographic information systems (GIS) in the KhokKaow national forest, MahaSarakhm province, Thailand.

II. MATERIAL AND METHODS

A. Study area

The KhokKaow national forest the located cover ChuenChom district, MahaSarakhm province, Thailand. The study are lies between 16.31° to 16.32° N Latitude and 103.06° to 103.10° E Longitude shown in Fig 1.

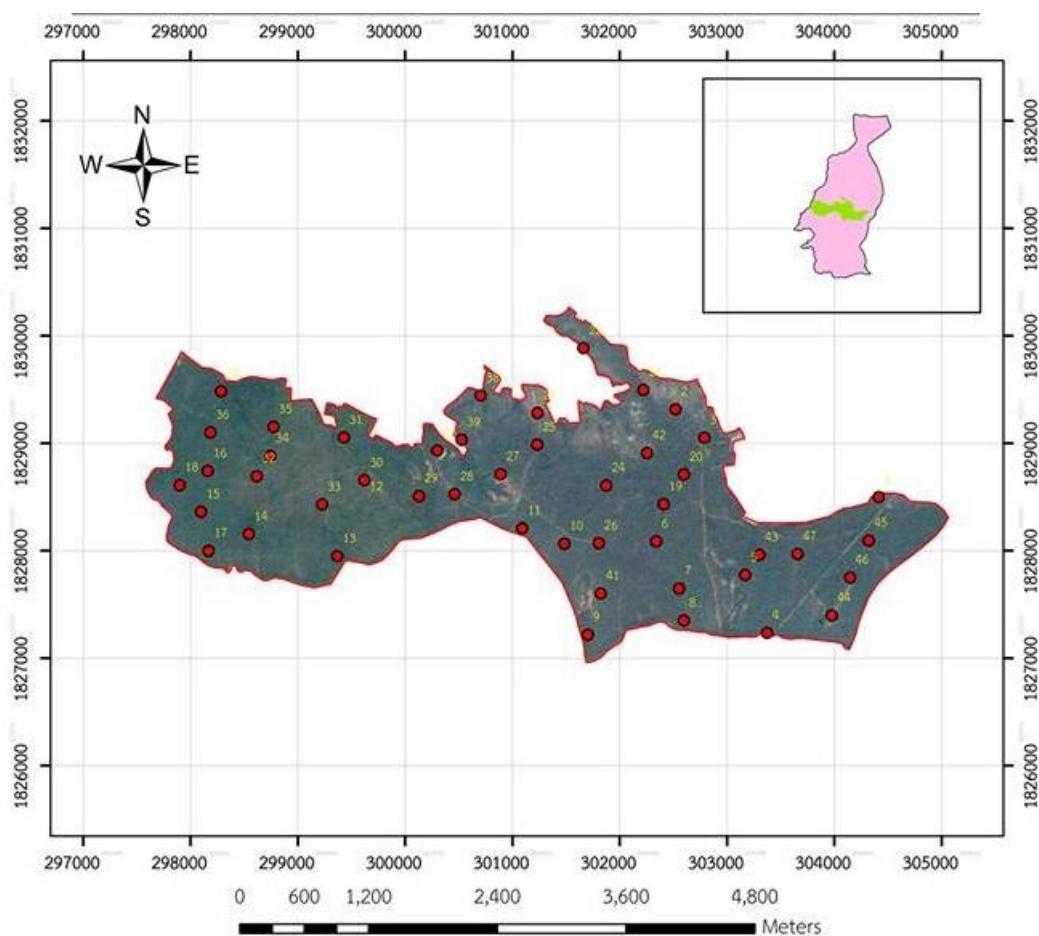


Fig 1. The study area, KhokKaow national forest, MahaSarakhm, Thailand.

B. Image Classification from satellite imagery using NDVI

The normalized difference vegetation index (NDVI) was used to classification of forest type in the study area. NDVI was used in several application for classified land cover [6-8] and used for estimated the carbon sequestration of the tree [9-12]. The ability of NDVI can be separate healthy vegetation from other land cover types. In their original equations, they provide normalized values in the interval from -1 to 1. They show higher values for vegetation, positive low values for water and bare soils and negative index values for clouds. The NDVI is a normalized ratio of NIR (near infrared) and Red (red band) defined as [13]:

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

C. Data Collection and Analysis the biodiversity of plants

1) Data collection and analysis the biodiversity of plants

Planning for observation of plant biodiversity in the study area used the sampling plot was the enumeration of randomly sample plots using the stratified random method [12]. The total of sampling plot was 47 plots by each plot has a dimension of 40 m. x 40 m. Data collection was conducted to all tree plant with the height of trees greater than 120 cm found in the observation plots. The attribute of data collection was record include: name species, name of trees, number, height, and diameter. The parameter for definition of the biodiversity indexes using the Shannon-Weiner index methods [13]. The parameter for analysis of important of the plant species by using the relative density (RD), relative domination (RDo), relative frequency (RF), and importance value index (IVI) [14-17].

2) Spatial interpolation using Inverse Distance Weighting (IDW)

Interpolation predicts values for cells in a raster from a limited number of sample data points. It can be used to predict unknown values for any geographic point data, such as elevation, rainfall, chemical concentrations, noise levels, and so on. Inverse Distance Weighted (IDW) is a method of interpolation that estimates cell values by averaging the values of sample data points in the neighborhood of each processing cell. The closer a point is to the center of the cell being estimated, the more influence, or weight, it has in the averaging process. This method assumes that the variable being mapped decreases in influence with distance from its sampled location [18].

D. Proposes Methods

This paper proposed the methods to evaluated the plant biodiversity using the technique of geoinformatics, the step following:

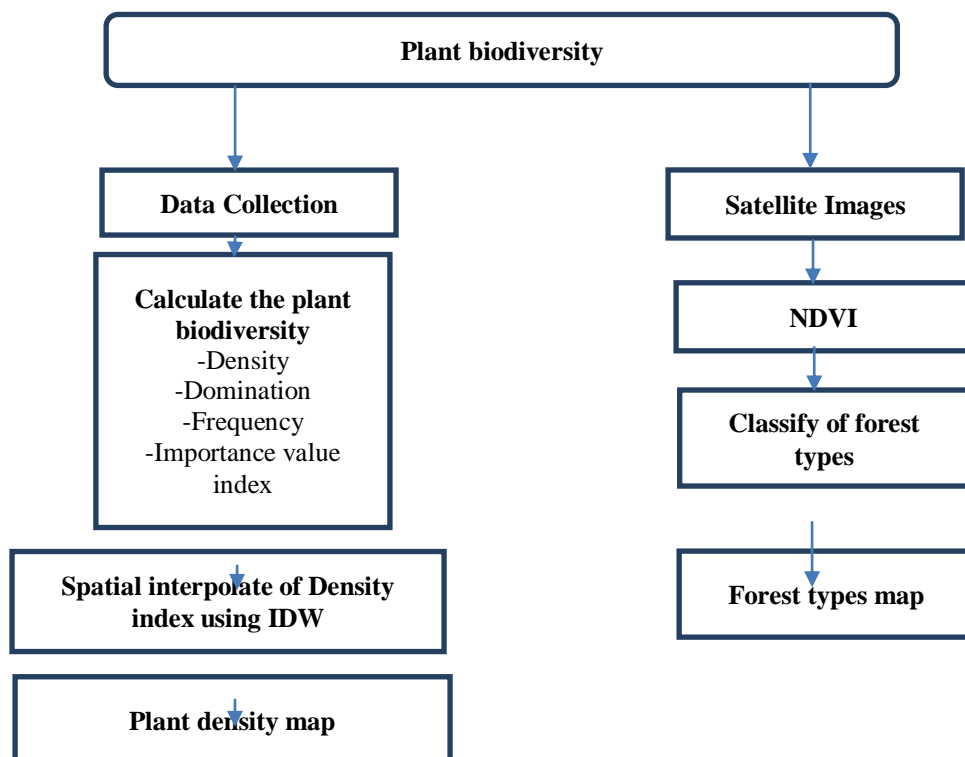


Fig 2. Proposes methods

III. RESULTS

A. The result of land cover classification from satellite image using NDVI index

The results of forest type classified using the vegetation index namely NDVI from the satellite imagery was classified into 4 classes are the water bodies, open deciduous forest, dry deciduous forest, and closed deciduous forest the results shown in Fig 3:

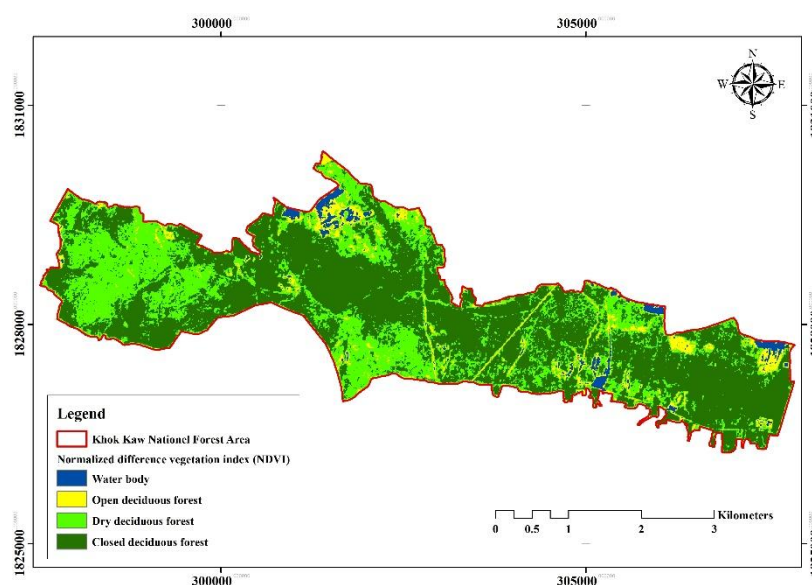


Fig 3. Forest type classification

B. The results of plant biodiversity and analysis of important index

The results of the data collected from the field surveyed sample plot with 47 plots found that the total number of 2,421 trees. The results revealed that the diversity of tree were 61 species. The results of the plant species by used the RD, RDo, RF, and IVI values show that the rank of highest value to lowest value by IVI shown in Table 1.

Table 1. The results of importance value index (IVI) value

ID	Name	Number of Tree	RD	RF	RDo	IVI
1	<i>Xylixyllocarpa</i>	372	15.36	6.21	12.45	34.02
2	<i>Ellipanthustomentosus</i> Kurz.	270	11.15	6.35	10.91	28.41
3	<i>Dipterocarpus tuberculatus</i> Roxb.	220	9.09	3.32	11.49	23.9
4	<i>horeasiamensis</i>	149	6.15	4.47	6.81	17.44
5	<i>Buchananialatifolia</i> Roxb.	108	4.46	5.63	4.75	14.84
6	<i>Glutausitata</i> (Wall.) Ding Hou.	109	4.5	3.46	4.8	12.77
7	<i>Canariumsubulatum</i> Guillaumin	82	3.39	4.62	4.64	12.65
8	<i>Dipterocarpus Obtusifolius</i> Teijsm.exMiq.	114	4.71	2.45	4.15	11.31
9	<i>Shoreaobtusa</i> Wall.	90	3.72	3.61	3.61	10.93
10	<i>Pterocarpus macrocarpus</i>	67	2.77	3.75	3.64	10.16
...
55	<i>Diospyros filipendula</i> Pierre ex Lecomte	1	0.04	0.14	0.04	0.22
56	<i>Hymenopyramisparvifolia</i> Moldenke	1	0.04	0.14	0.04	0.22
57	<i>Terminalia alata</i> Heyne ex Roth	1	0.04	0.14	0.03	0.22
58	<i>Peltophorumpterocarpum</i> (DC.) K.Heyne	1	0.04	0.14	0.03	0.22
59	<i>Diospyros ebenum</i>	1	0.04	0.14	0.03	0.22
60	<i>Phyllanthus emblica</i> L.	1	0.04	0.14	0.03	0.22
61	<i>Careyaarborea</i> Roxb.	1	0.04	0.14	0.03	0.21
Tital		2,421	100	100	100	300

In the Table 1. found that the most of trees from the highest of the IVI value was *Xylixyllocarpa* (34.02), *Ellipanthustomentosus*Kurz (28.41), and *Dipterocarpus tuberculatus*Roxb. (23.9), respectively. The lowest value of IVI was *Careyaarborea*Roxb. (0.21), *Phyllanthus emblica* L. (0.22), and *Diospyrosebenum* (0.22), respectively.

C. The results Mapping of plant density using IDW

The result of forest density map from the relative density (RD) using the interpolated of IDW technique shown in Fig 4.

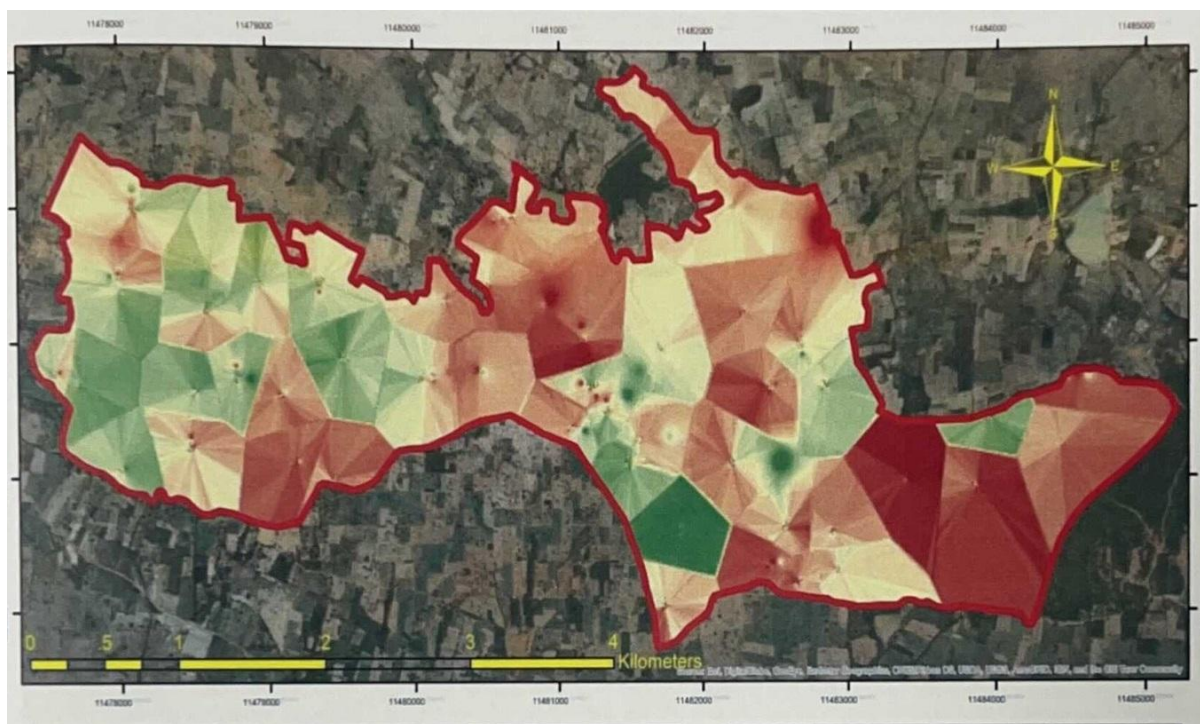


Fig 4. Plant density map from relative density using IDW

IV. DISCUSSION AND CONCLUSION

The experiment results of forest type classification by using the NDVI index shown in Figure 3 and percentage of an area for the forest type in the KhokKaow national forest show that the highest vegetation of forest (Closed Deciduous Forest) found that the central region of the KhokKaow national forest, and lowest vegetation forest (Open Deciduous Forest) found that the a little region of KhokKaow national forest.

The KhokKaow national forest found that the plants from 61 species and 31 families. The relative of plant biodiversity for rank of three highest value of IVI was *Xylixylcarpa*, *Ellipanthustomentosus* Kurz, and *Dipterocarpus tuberculatus* Roxb., respectively. The rank of three lowest value of IVI was *Careyaarborea* Roxb., *Phyllanthus emblica* L., and *Diospyrosebenum*, respectively. The relative density (RD) and relative domination (RDo) show rank of three highest value was *Xylixylcarpa*, *Ellipanthustomentosus* Kurz, and *Dipterocarpus tuberculatus* Roxb., respectively. The rank of three lowest value of RD and RDo was *Careyaarborea* Roxb., *Phyllanthus emblica* L., and *Diospyrosebenum*, respectively. The relative frequency (RF) show rank of three highest value was *Ellipanthustomentosus* Kurz, *Xylixylcarpa*, and *Buchananialatifolia* Roxb., respectively. The rank of three lowest value of RF was *Careyaarborea* Roxb., *Phyllanthus emblica* L., and *Diospyrosebenum*, respectively.

The results of the spatially interpolated plant density map shown in figure 4 found that the green color is high plant density found that the west and south region of the KhokKaow national forest. The high density of the map has a relationship with the sampling plot at plot numbers 3, 11, 15, 17, 19, and 45.

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