



# Development of Geo-informatics system for monitor and analysis changes in biodiversity of the Doi Inthanon National Park

*Dr. Surachai RATANASERMPONG*

GISTDA

Department of National Park, Wildlife and Plant Conservation

Kasetsart University

Maejo University



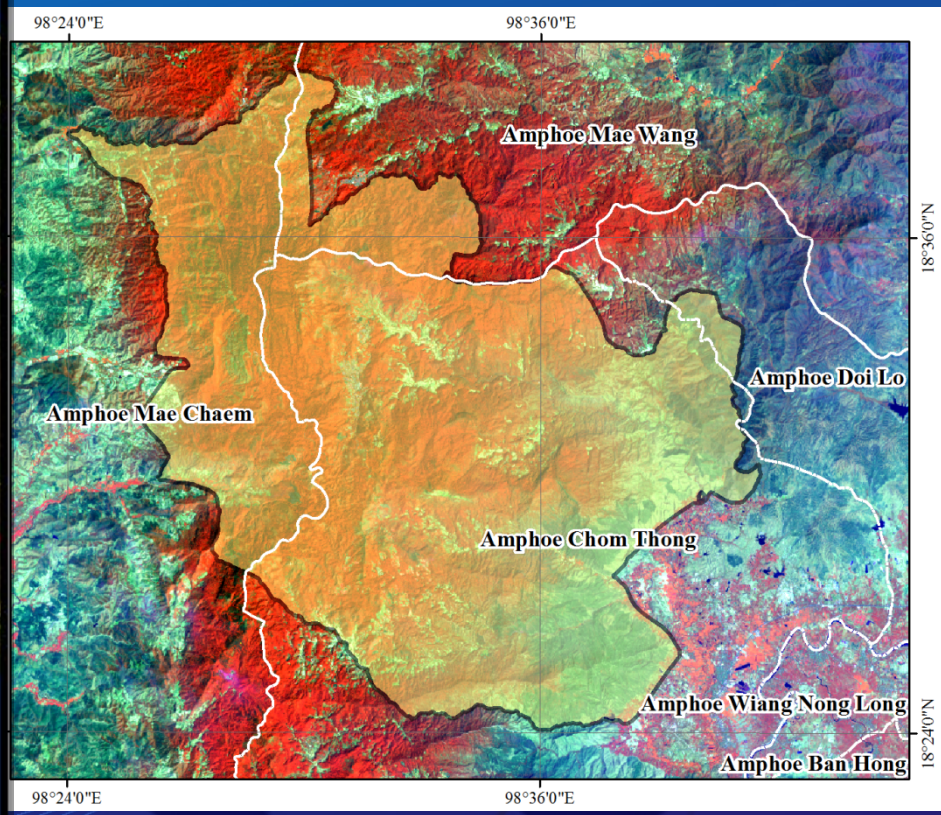


## OBJECTIVE

- ❖ **To develop a methodology of applying geo-informatics in biodiversity research**

# Study Area

## Doi Inthanon National Park Chaing Mai, Northern Thailand



2008	2009	2010	2011
64,216	440,232	409,106	437,914



## Doi Inthanon National Park



- Highest mountain (2,565 m. MSL)
- Area of 48,240 ha.
- Rainfall > 2,000 mm.
- Temperature 4 ° – 20 ° C
- Forest rich in biodiversity
- Beautiful flowers : Vandal orchid, Rhododendron, Sphagnum Moss, Osmanda fern
- Largest bird species (362)



## Animals in Doi Inthanon

- ❖ *Capricornis sumatraensis* or Common serow
- ❖ *Naemorhaedus griseus* or Chinese goral
- ❖ Wild boar , Bear, Gibbon , Burmese hare
- ❖ Red jungle fowl
- ❖ Birds



# Doi Inthanon National Park

rganization)



360 m. at  
First  
Check  
Point

Doi Inthanon 2,565 m.msl

Doi Hua Suea 1,864 m. msl

Hill Evergreen Forest : 1,340-2,320 m. MSL

Pine Oak Forest : 1,020-1,180 m. MSL

Pine Dipterocarp Forest : 980-1,100 m. MSL

Dry Dipterocarp Forest : 450-900 m. MSL

Mixed Deciduous Forest : 490-730 m. MSL



# DATA

## Multi-temporal Satellite imagery

SATELLITES	Acquisition Date	Resolution (m.)
SPOT-5	4 March 2007	Pan 2.5 Multi 10
	15 December 2007	Pan 2.5 Multi 10
LANDSAT5-TM	25 March 2010	B1-B5,B7 30 m. B6 120 m.
THAICHOTE (THEOS)	2 January 2010	Pan 2 Multi 15
	28 January 2010	Pan 2 Multi 15



# EQUIPMENT

- **Image processing programs (Erdas Imagine)**
- **Image processing programs (Definient Developer)**
- **GIS programs (ArcGIS)**
- **Microsoft Excel**
- **Measurement tape 50 m.**
- **DGPS receiver**
- **Hemi view programs**



# Methodology

## Field Measurement (field survey)

- Random Sampling Plot 40x40 m. (39 plots)
- diameter at breast height (dbh.) and total height of trees (secondary data)
- Measure LAI and % Forest Crown cover by take photo with fisheyes lens
- GCPs using DGPS

## Biophysical Parameter

- Digital Elevation Model (LDD) 5m.
- Forest crown cover density
- Vegetation index
- Surface Temperature (Average)

Calculate % crown cover from field survey

## Further work

1. Correlation between biomass and forest crown cover density
2. Carbon stock (In Conservation Forest Area)

SPOT-5  
2007

LANDSAT5-TM  
2010

THAICHOTE  
(MS-PAN)  
2010-2011



## Pre-processing

- Atmospheric correction
- Ortho rectification

SPOT5  
Ortho imagery

LANDSAT5-TM  
Ortho imagery

THAICHOTE 2 m.  
Pan-sharpened  
Image

Object based  
analysis  
(Create rule set)

1.Forest crown cover density : FCD  
2. Surface Temperature (band 6  
LANDSAT5) of different forest types

-Transportation  
-Villages  
-Protection Units

Ground Check  
and Editing

Forest types and LC  
Map (2007)

Forest types and LC  
Map (2010-2011)

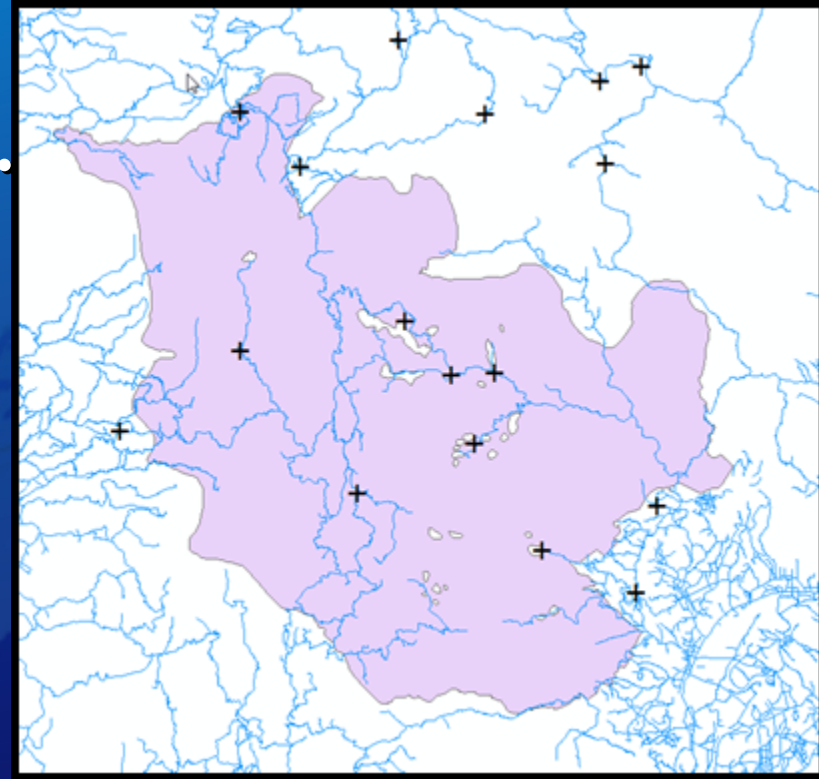
Mapping and Report

Change Detection and Monitoring  
for National park management



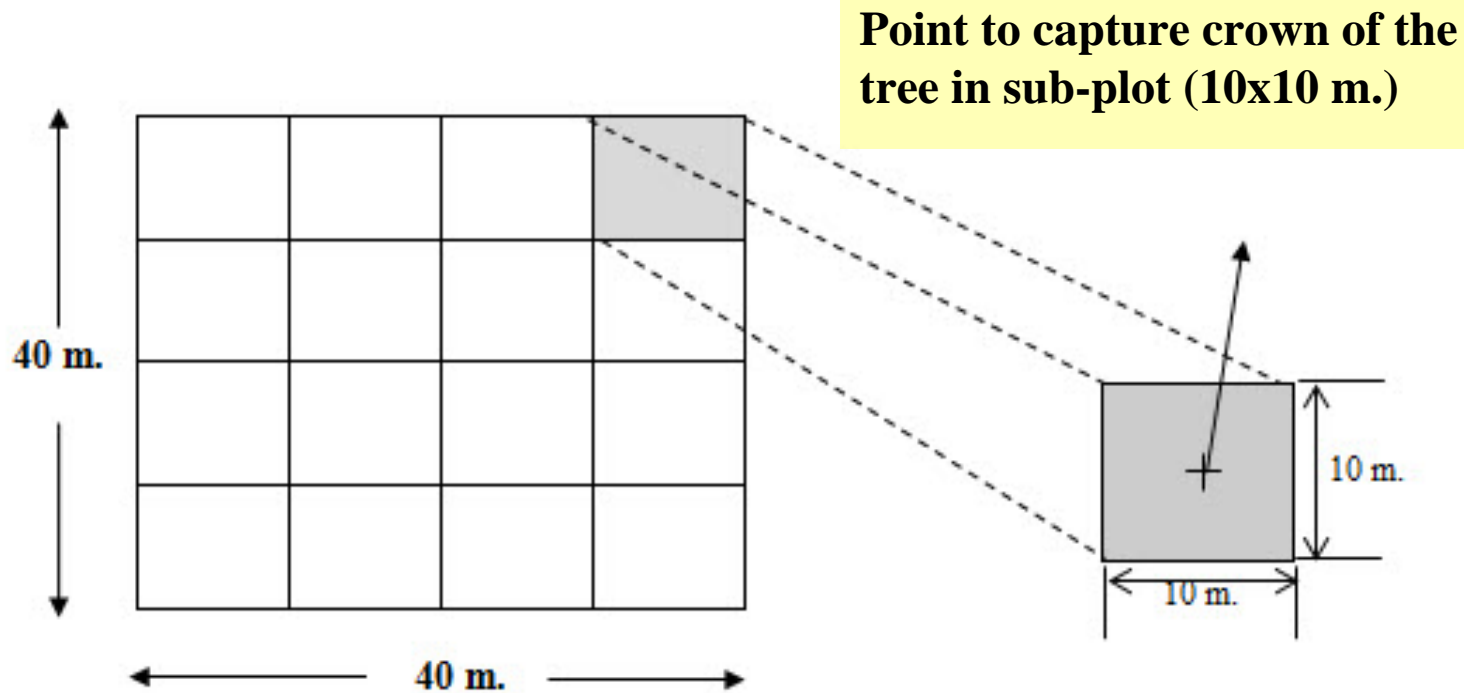
# Field Survey

-Ground Control Point : DGPS.



# LAI & % Crown cover measurement

-LAI (fish eyed lens; divided a sample plot, 40x40 m. into 16 sub-plot of 10 x 10 m )



The picture from fish eyes lens

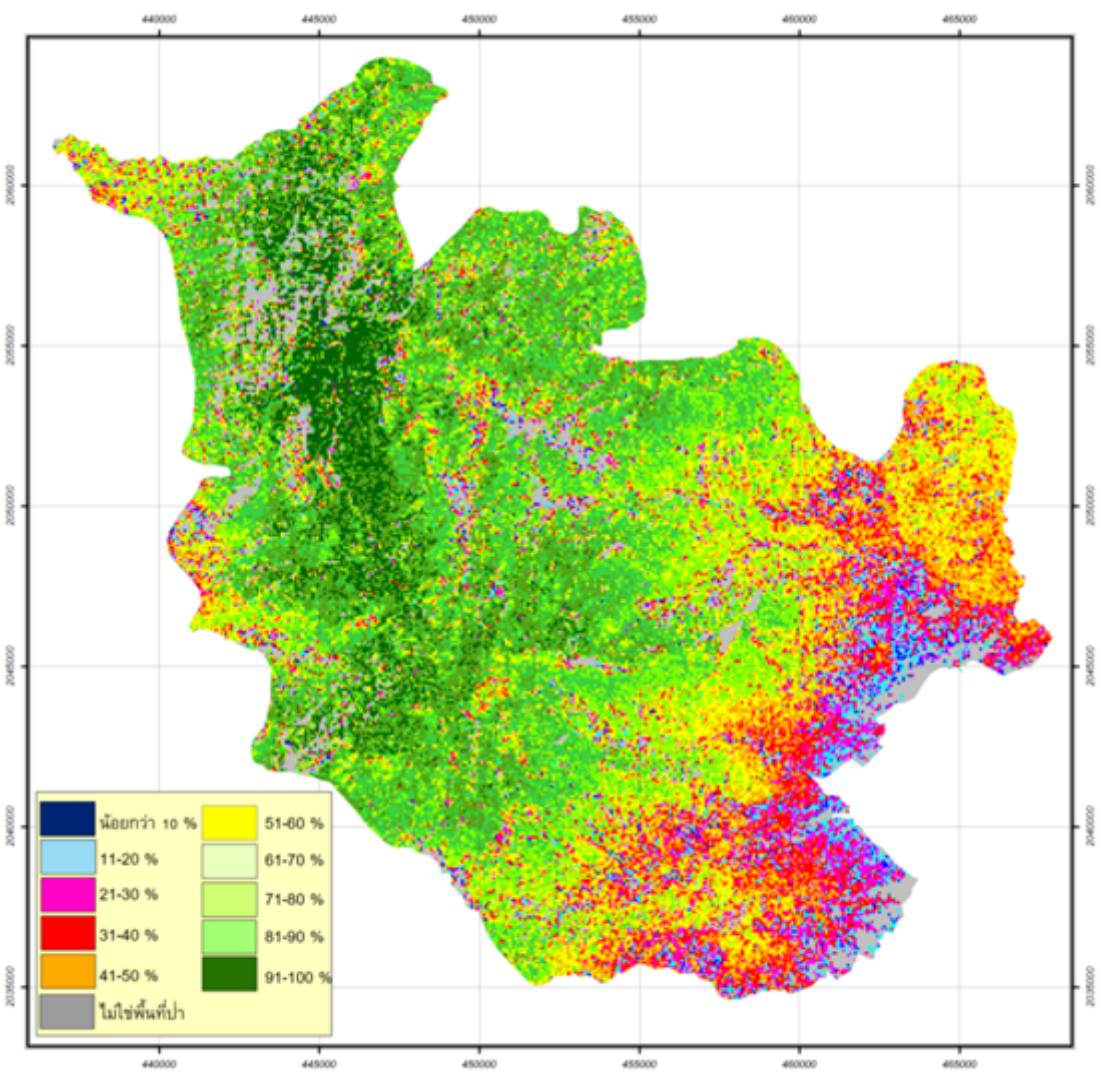
# Calculated % crown cover using FCD Model

- Forest Canopy Density(FCD) using LANDSAT5-TM Data

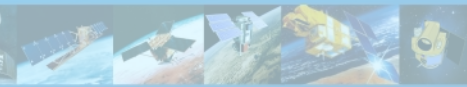
-FCD Mapper by Japan Overseas Forestry Consultants Association (JOFCA) : International Tropical Timber Organization (ITTO)

Index	Formula	
AVI (Advanced Vegetation Index)	$AVI = (NIR \times (256 - Red) \times (NIR - Red))^{1/3}$	—1
BI (Bare Soil Index)	$BI = \{[(SWIR + R) - (B + NIR)] / [(SWIR + R) + (B + NIR)]\}$	—2
SI (Shadow Index)	$SI = [(256 - Blue) \times (256 - Green) \times (256 - Red)]^{1/3}$	—3
TI (Thermal Index)	Calibrated Values of Thermal Band	—4
VD (Vegetation Density)	$FC = (VI \times SI \times (256 - BI) + 1)^{1/3}$	—5
FCD (Forest Canopy Density)	$FCD = (VD \times SSI + 1)^{1/2} - 1$	—6

# % Crown Cover Density Map



Classes	Area (ha.)
< 10%	1,882.12
11-20%	4,497.18
21-30%	7,606.68
31-40%	11,799.56
41-50%	17,201.25
51-60%	21,939.19
61-70%	22,412.25
71-80%	18,478.12
81-90%	10,454.06
91-100%	33,84.56
Non-forest	22,222.69
<b>Total</b>	<b>141,877.7</b>



## Summary data of the study plots in Doi Inthanon National Park

Forest type	Number of Plots	Elevation (m.) MSL	Number of Families	Number of Species	% Crown Cover	Leaf area index (LAI)
DDF	9	450-990	25	70	0.534	1.058
MDF	7	490-730	24	75	0.691	1.449
PDF	5	980-1,100	29	70	0.705	1.585
POF	9	1,020-1,180	38	95	0.675	1.591
<b>HEF</b>	<b>9</b>	<b>1,340-2,320</b>	<b>48</b>	<b>144</b>	<b>0.764</b>	<b>1.802</b>

--5 Forest types → Dry Dipterocarp Forest (DDF) Mixed Deciduous Forest (MDF)  
 Pine Dipterocarp Forest (PDF) Pine Oak Forest (POF)  
 Hill Evergreen Forest (HEF)

-- Total of **289 species, 150 genera and 69 families**

# Dry Dipterocarp Forest (DDF)



Elevation

450-990 m. MSL

%Crown Cover

53 %

Dominant spp.

*Shorea siamensis* (รัง), *Shorea obtusa* (เต็ง)  
*Dipterocarp tuberculatus* (ยางพลวง)

# Mixed Deciduous Forest (MDF)



Elevation

490-730 m. MSL

%Crown Cover

69 %

Dominant spp.

*Tectona grandis*, *Xylia xylocarpa*

*Milletia leucantha*

*Canarium subulatum*



# Hill Evergreen Forest (HEF)



Elevation

1,340-2,320 m. MSL

%Crown Cover

76 %

Dominant spp.

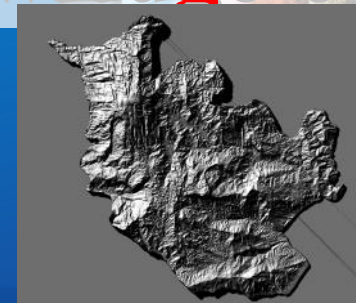
*Mastixia euonymoides*

*Drypetes indica*

*Castanosis calathiformis*

# LU/LC classification using knowledge based

## 1. Elevation from aerial photo (LDD)



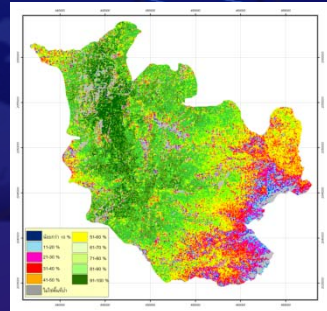
## 2. Surface Temperature from band 6 of LANDSAT-5 TM



## 3. Vegetation Index == NDVI from THAICHOTE

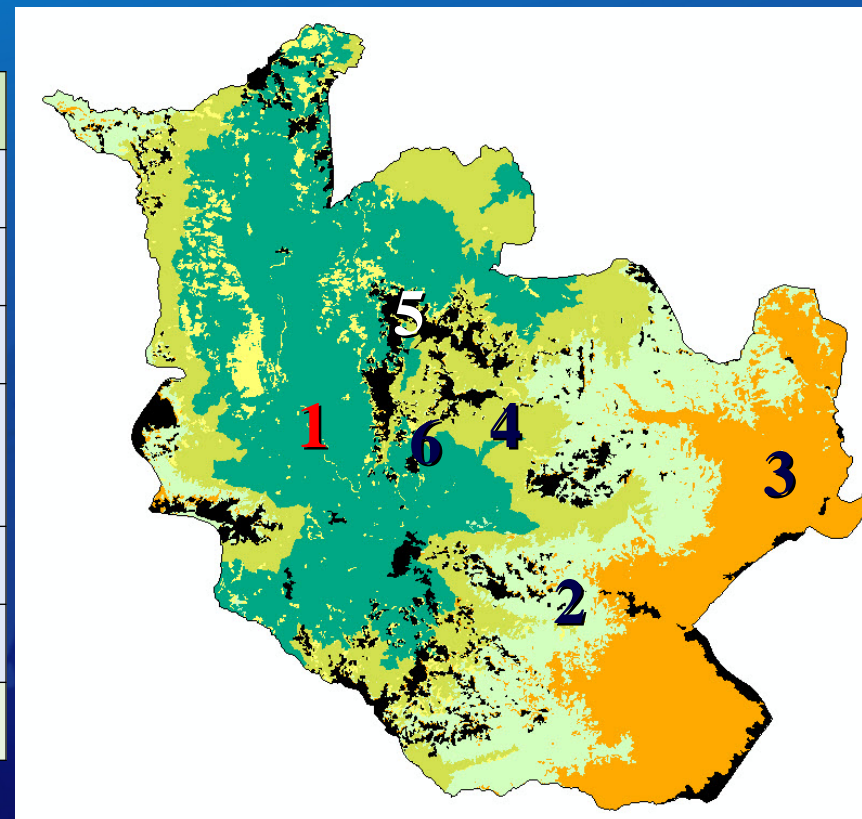


## 4. Percentage of Crown Cover == FCD Model

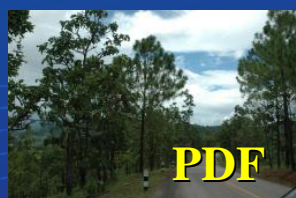
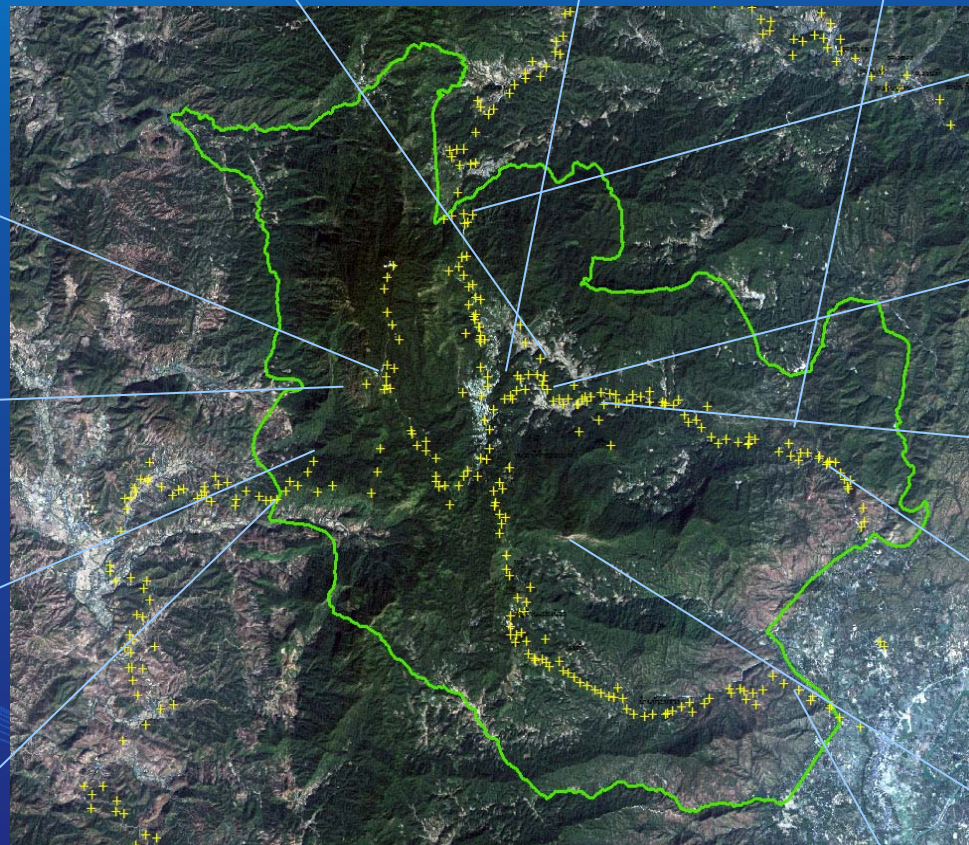
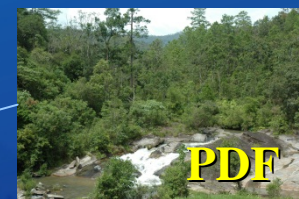


# Land use/Land cover of the Doi Inthanon National Park using Definient Programme (rule set from physical parameter)

	LU/LC	Area (ha.)
1	Hill Evergreen Forest (HEF)	14,751.7
2	Mixed Deciduous Forest (MDF)	9,274.4
3	Dry Dipterocarp Forest (DDF)	8,903.4
4	Pine Oak Forest (POF) & Pine Dipterocarp Forest (PDF)	9,117.9
5	Agriculture	4,088.5
6	Grass land	2,284.0
<b>Grand Total</b>		<b>48,419.9</b>

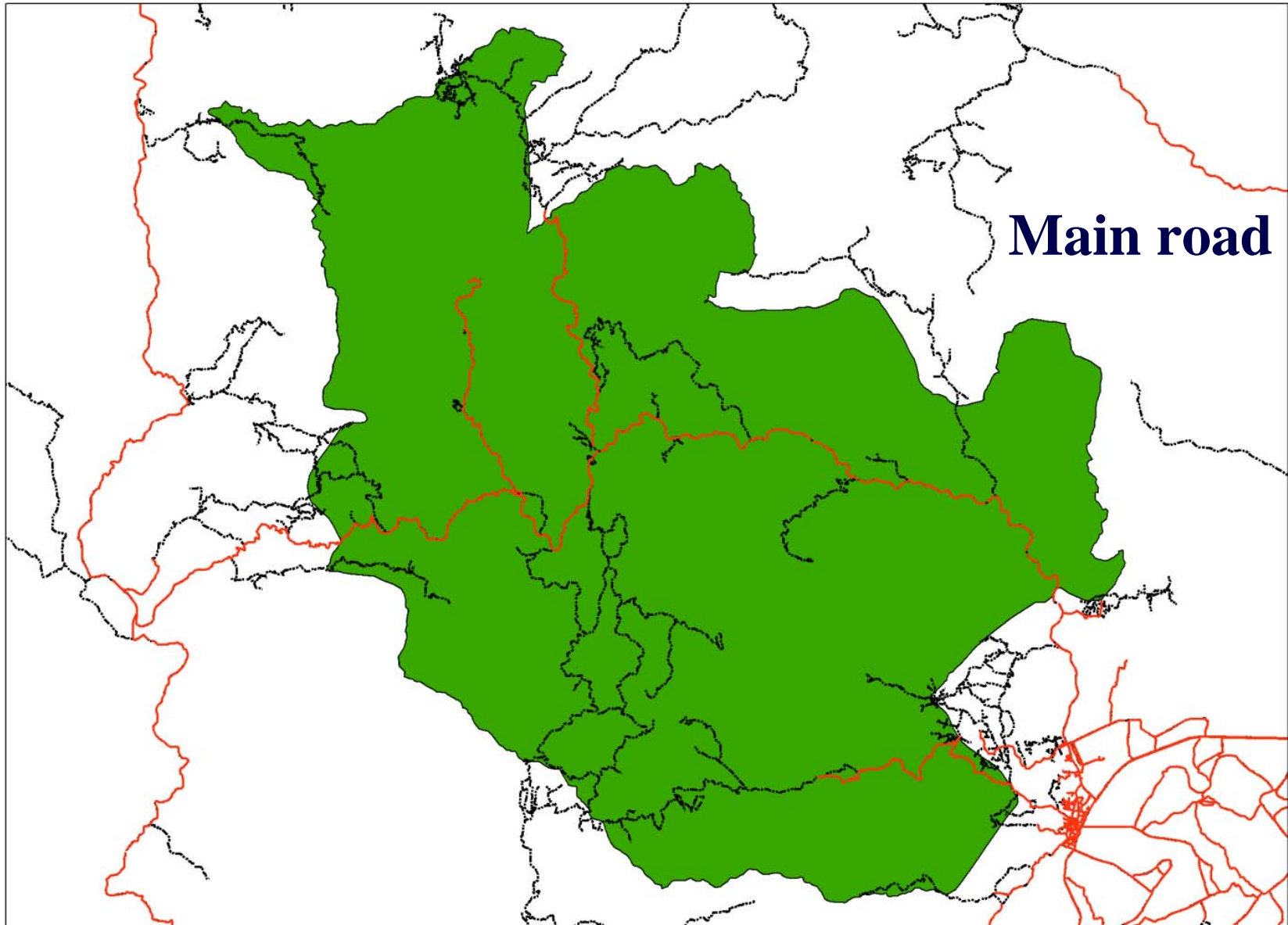


# Ground Truth



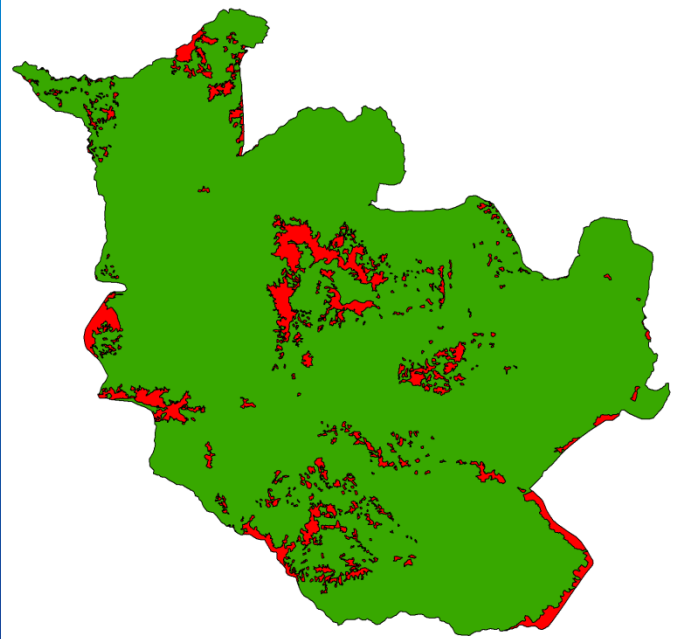


# Transportation

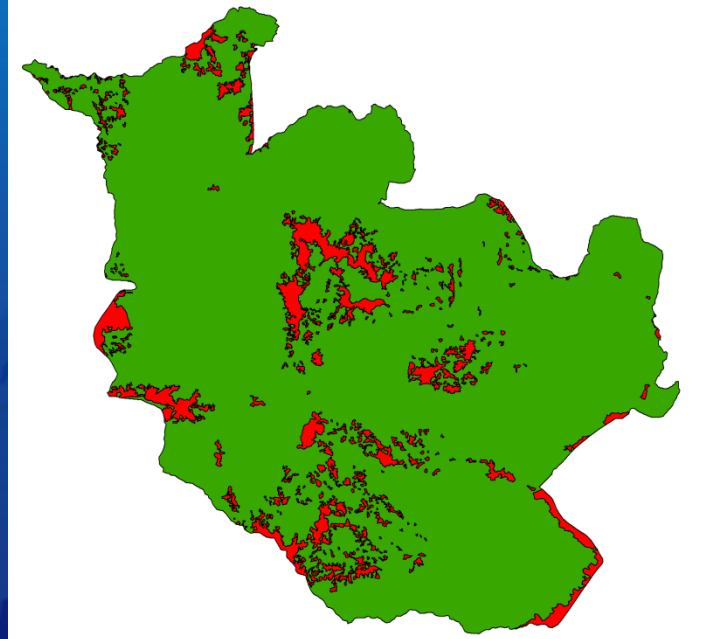




## Aerial Photo 2003-2004




## THAICHOTE 2010

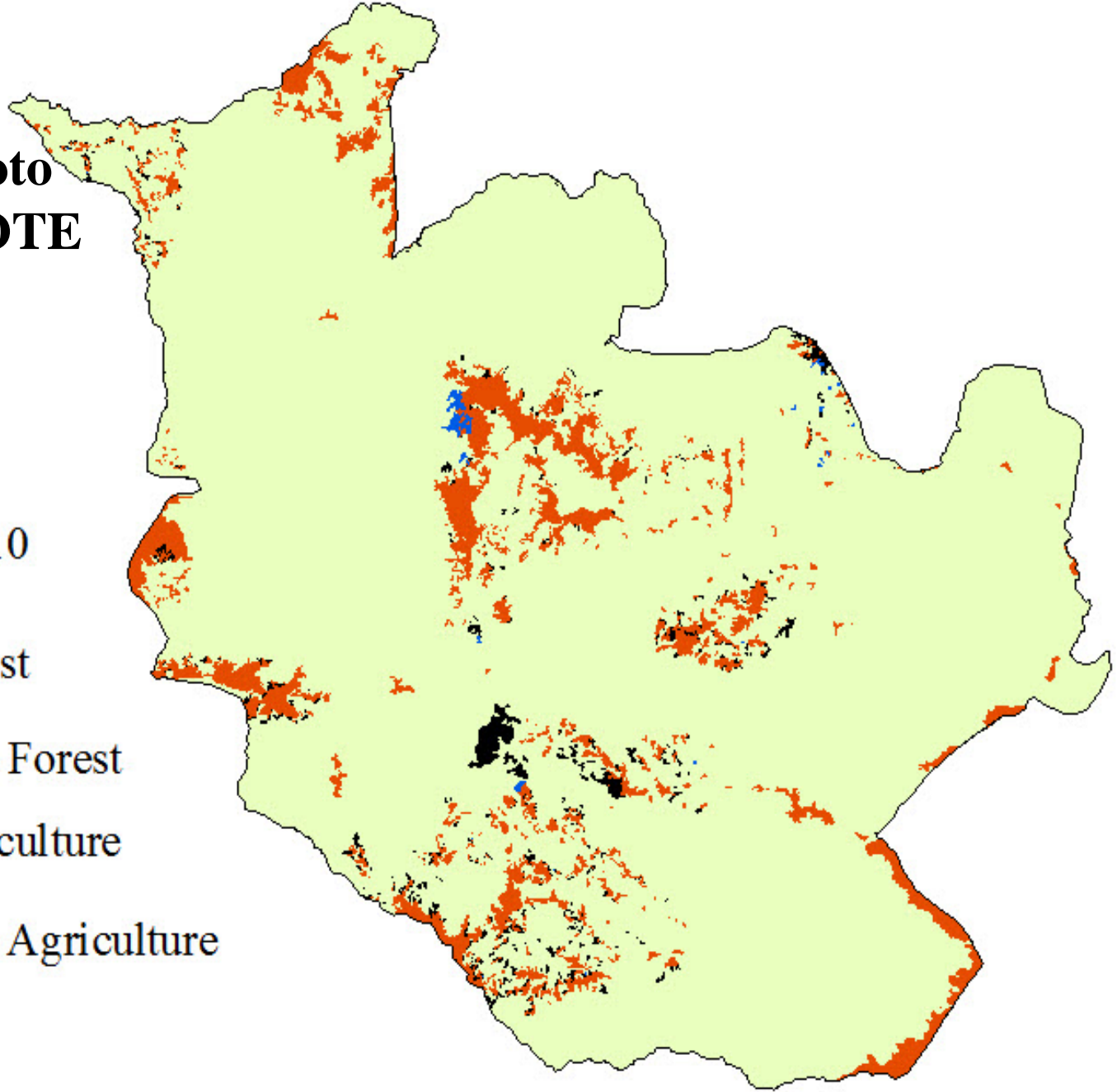


Year	Forest (ha.)	Agriculture & Others (ha.)
2003-2004	44,877.22	3,542.68
2010	44,331.41	4,088.82
Area Change	<b>-545.81</b>	<b>+546.14</b>

**2003 -- Aerial photo**  
**2010 -- THAICHOTE**

Change 2003 -- 2010

-  Forest -- Forest
-  Agriculture -- Forest
-  Forest -- Agriculture
-  Agriculture -- Agriculture





Change 2003 -- 2010

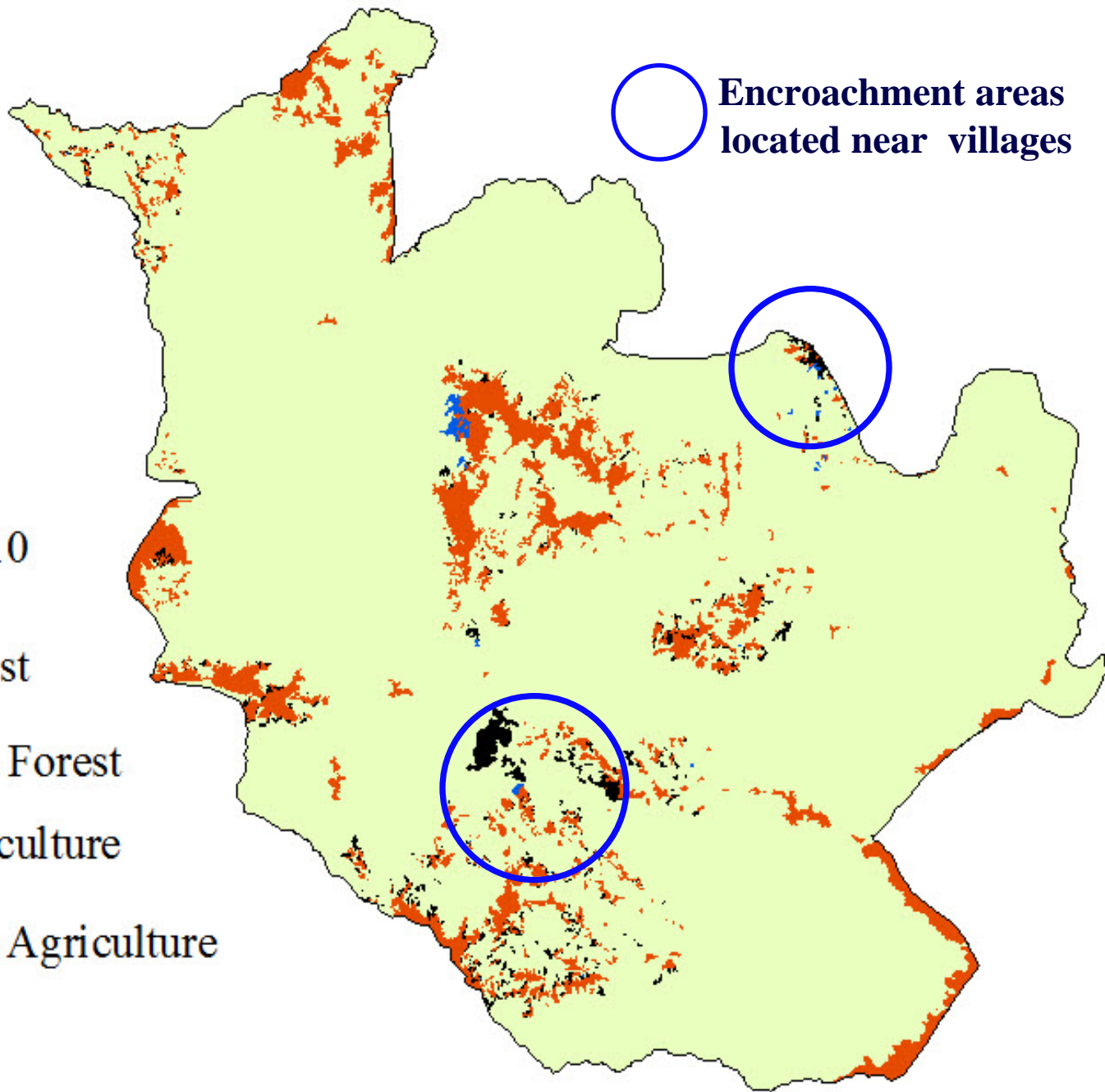
Forest -- Forest

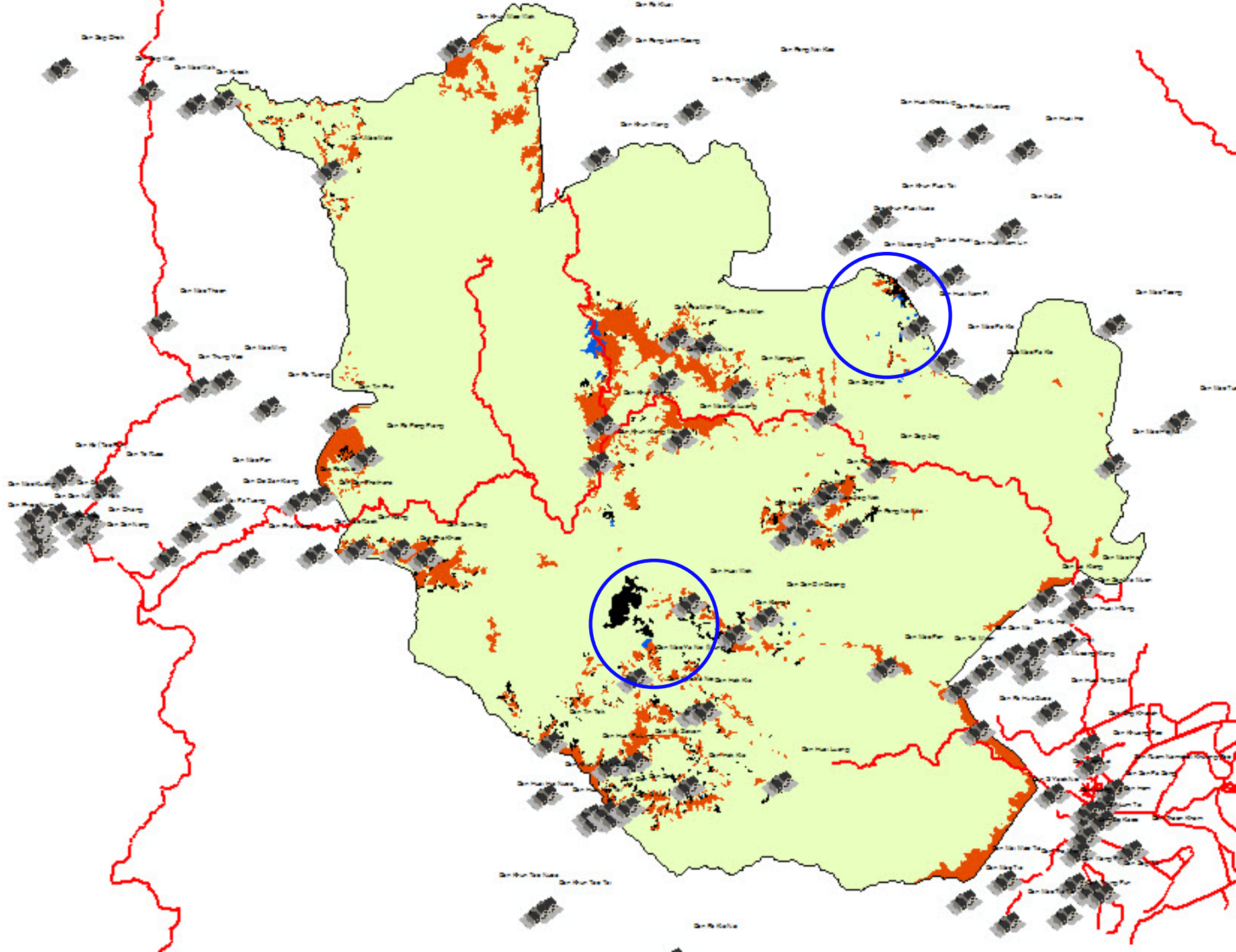
Agriculture -- Forest

Forest -- Agriculture

Agriculture -- Agriculture

Encroachment areas  
located near villages







## **Further work**

- ❖ **Develop a model for monitoring and prediction of plant biodiversity using satellite imageries and geo-informatics data**
- ❖ **Develop a model for biomass estimation and carbon stocking using Radar and Optical imagery**