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Urban Change Detection of Patheingyi Township Based on Random Forest Classifier

(Second Seminar)
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Abstract

- Urbanization is one of the most important components of global environmental change.
- The proposed system aims to detect changes that have taken place particularly in the built-up land and subsequently to analyze the urban sprawl of the different time periods in Patheingyi Township.
- The proposed system compares the urban area growth over a given period (2000,2005,2010 and 2015) in Patheingyi Township.

Objectives

- To develop the change detection system of urban area in Patheingyi Township
- To study the application and work flow of google earth engine and ArcGIS Desktop 10
- To identify urban growth changes by observing it at different times
- To assess the impacts of landscape transformations on ecosystems and resources

Introduction

- The world is becoming rapidly urbanized and this process needs to be monitored.
- One way of monitoring this process is to perform change detection in urban areas using satellite images.
- Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times.
- Change detection is not only used for urban applications but is used for detecting forest or landscape change, disaster monitoring and in many more applications.

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- Nowadays, urban research is shifting towards the use of digital, and towards the development of remote-sensing image classification.
- The main purpose of the system is to detect changes that have taken place particularly in the built-up land and to predict the urban area growth in four years period(2000 , 2005, 2010 and 2015).
- In this proposed system, Random Forest classifier is used to detect urban change area.

Study Area

- The proposed system aims to detect urban growth changes in Patheingyi township.
- Patheingyi township is located in the eastern part of Mandalay, Myanmar.
- Mandalay is incoporated with townships such as Patheingyi,Aungmyethazan,Chanayethazan,Pyigyitagon, Amarapua and Chanmyathazi.
- Patheingyi township is bounded by Aungmyethazan Township and Chanayethazan Township in the west.
- The study area is one that experienced a fast increase of urban population in the recent decades in Mandalay region.

Background Theory

- Classification is a general process related to categorization.
- There are two types of classification:
  - supervised classification
  - unsupervised classification
- The system uses supervised classification ; Random Forest Classifier.

Steps of Random Forest Classifier

- First, the random forest classifier randomly selects features and a combination of features at each node to grow a tree.
- Features are randomly selected with replacement.
- Gini index is used as an attribute selection measure.
- In dataset T, gini index is defined as

$$Gini(T) = 1 - \sum_{j=1}^{n} (p_j)^2$$

where, P_j is the relative frequency of class j in T

Cont’d

- After the calculation of gini index for selecting attribute, select the lowest gini index value.
- Mid point of every pair of consecutive values is chosen as the best split point for the attribute.
- The procedure is repeated for the remaining attribute in the dataset.
- Each tree is fully grown for the training dataset.
- Finally, the decision tree is taken the most popular voted class from all the tree predictors in the forest.

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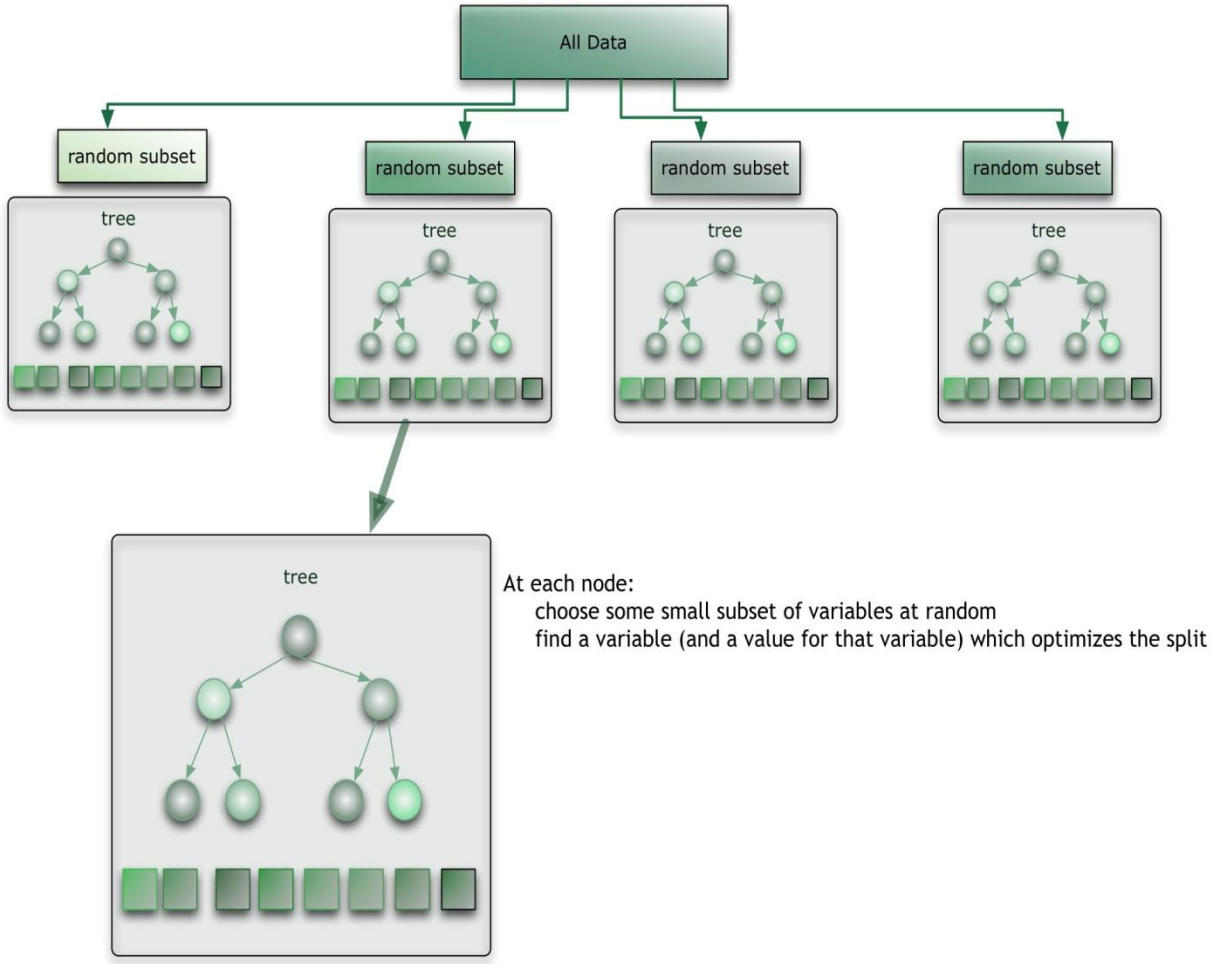
- In this system, the training data are polygons representing homogenous regions, every pixel in each polygon is a training point.
- To collect training data interactively in Earth Engine, use the geometry drawing tools.
- The training data is a Feature Collection with a property storing the class label and properties storing predictor variables.
- Then, the training sample is used to train the classifier.
- Finally, the resulted image is generated and changing area is represented with a map.
- Hand calculation

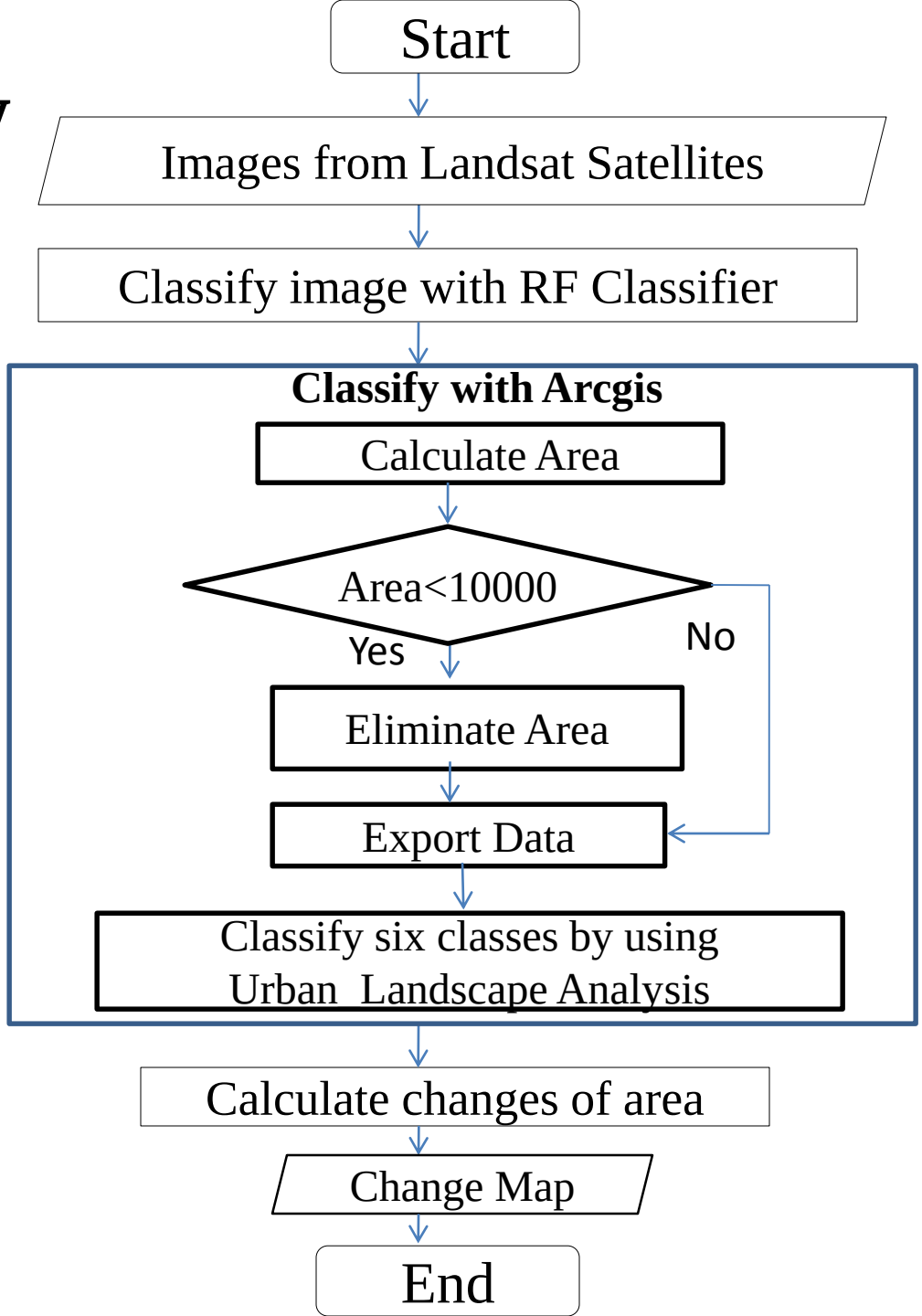
Random Forest Algorithm



Benefits of Random Forest Classifier

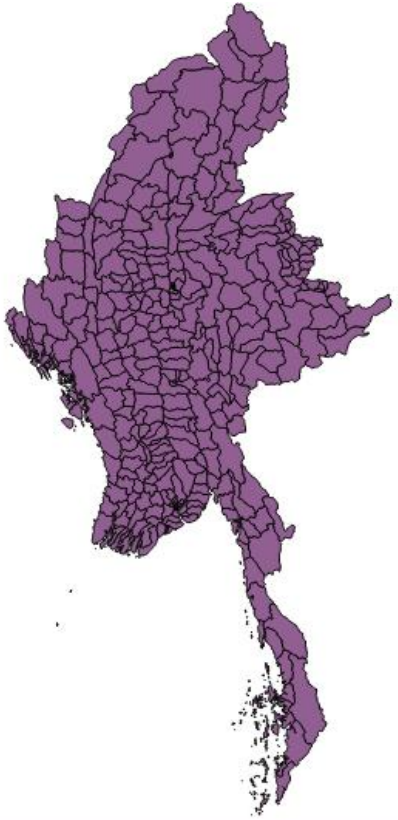
- It is one of the most accurate learning algorithms available.
- For many data sets, it produces a highly accurate classifier.
- It runs efficiently on large databases.
- It can handle thousands of input variables .
- It gives estimates of what variables are important in the classification.
- It has an effective method for estimating missing data and maintains accuracy when a large proportion of the data are missing.

System Flow


Start
Images from Landsat Satellites
Classify image with RF Classifier
Classify with Arcgis
Calculate Area
Area<10000
Yes
No
Eliminate Area
Export Data
Classify six classes by using
Urban Landscape Analysis
Calculate changes of area
Change Map
End

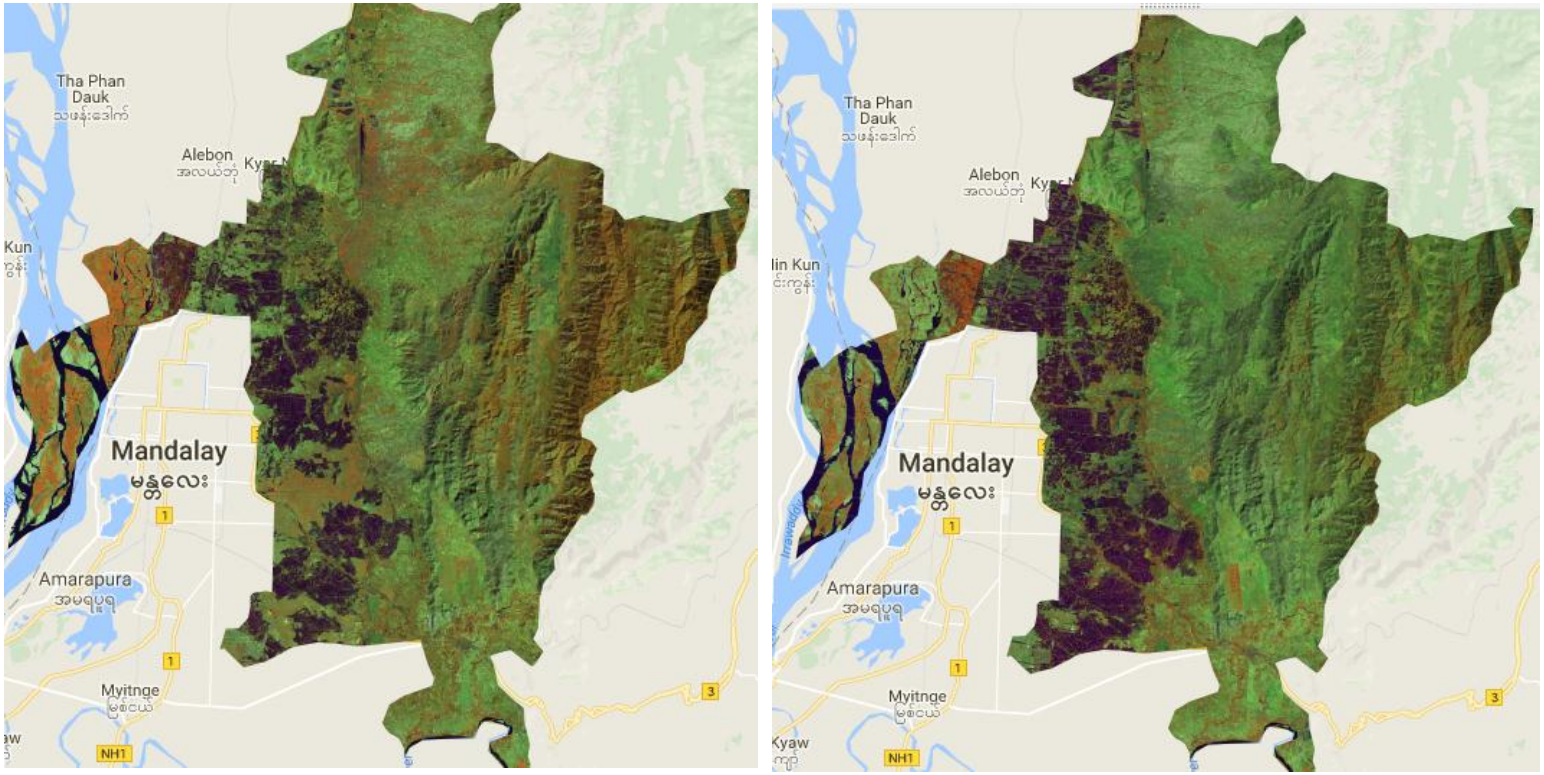
Dataset

- Dataset gets from Myanmar Information Management Unit.
- Dataset link,



Myanmar Region Dataset

Original Image



Patheingyi Region Map in 2000 and 2005

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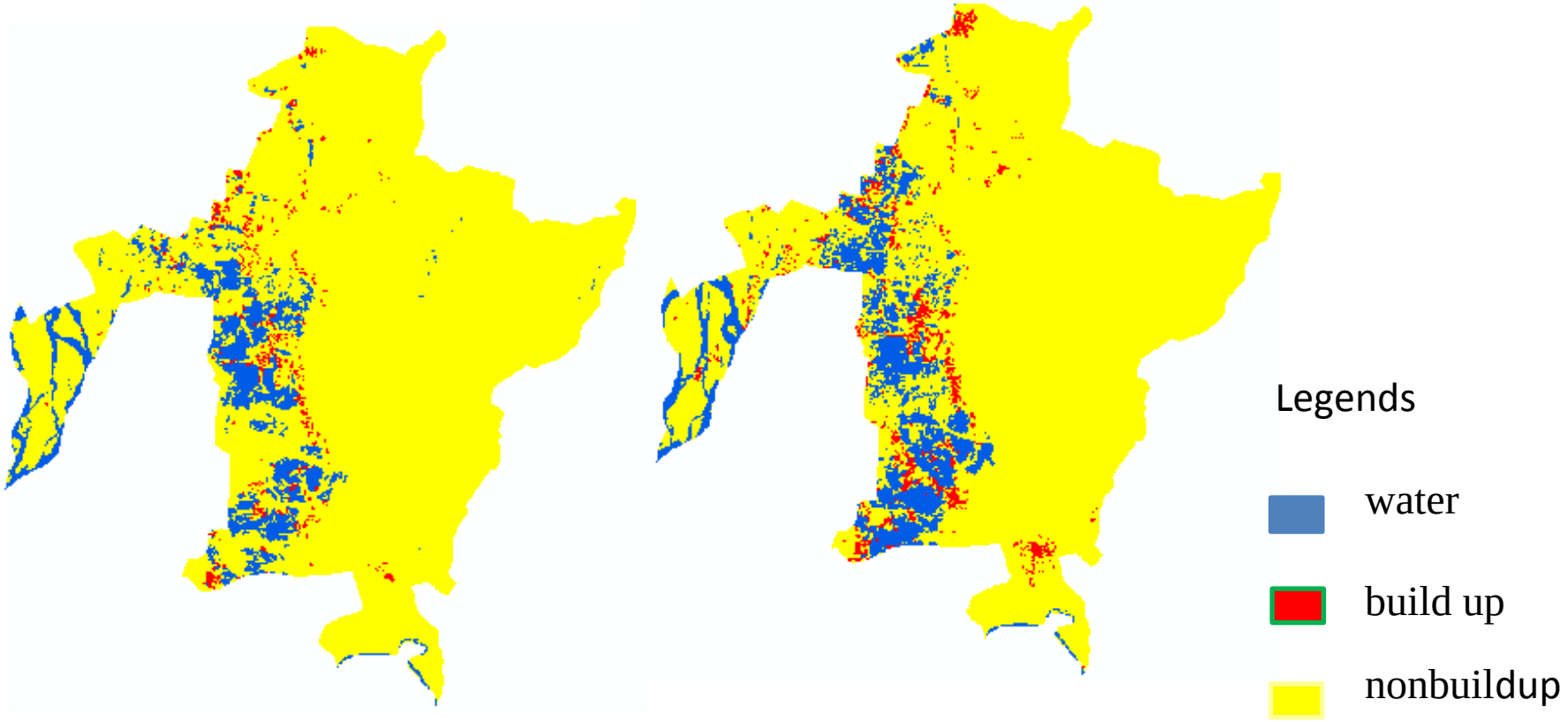
Patheingyi Region Map in 2010 and 2015

Classification of area using Random Forest Classifier



Patheingyi Township in 2000 and 2005

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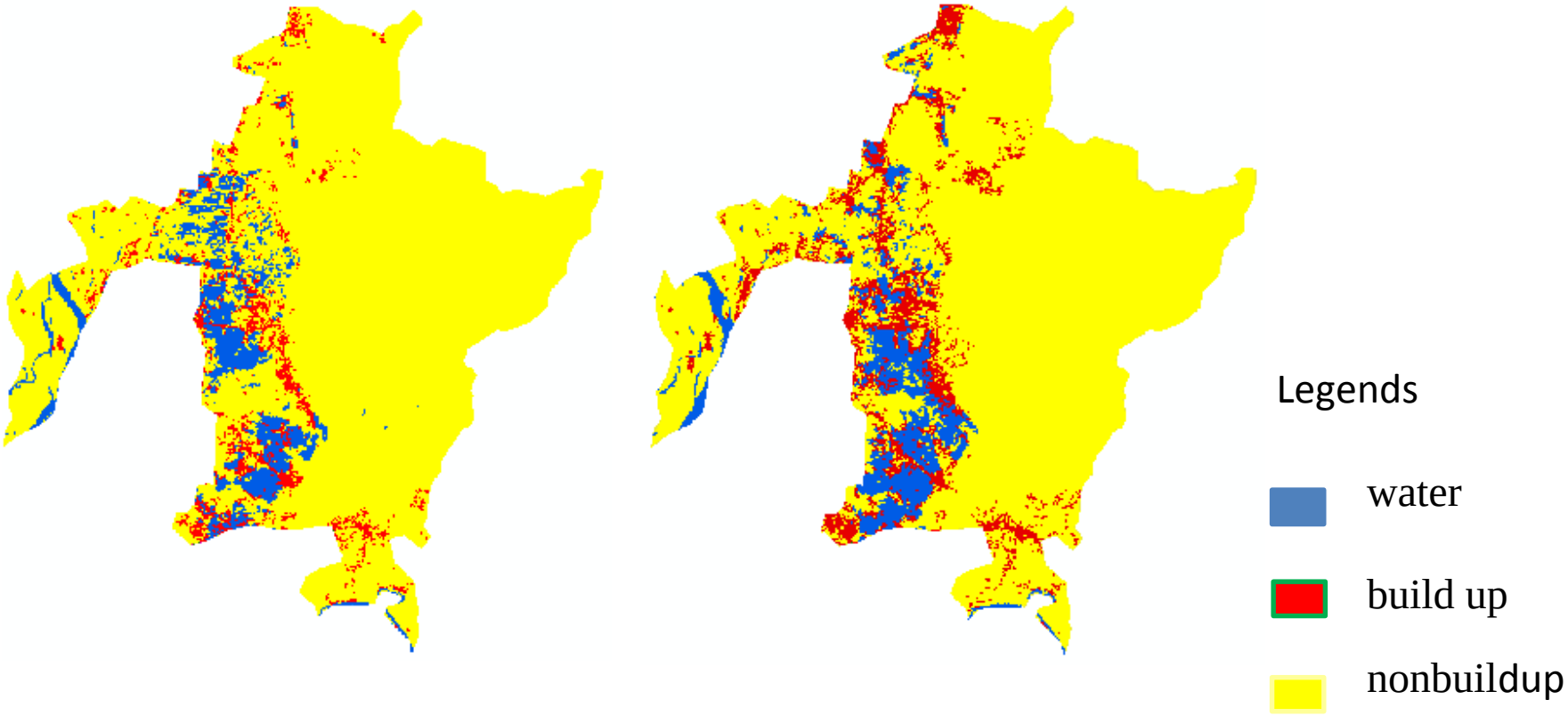
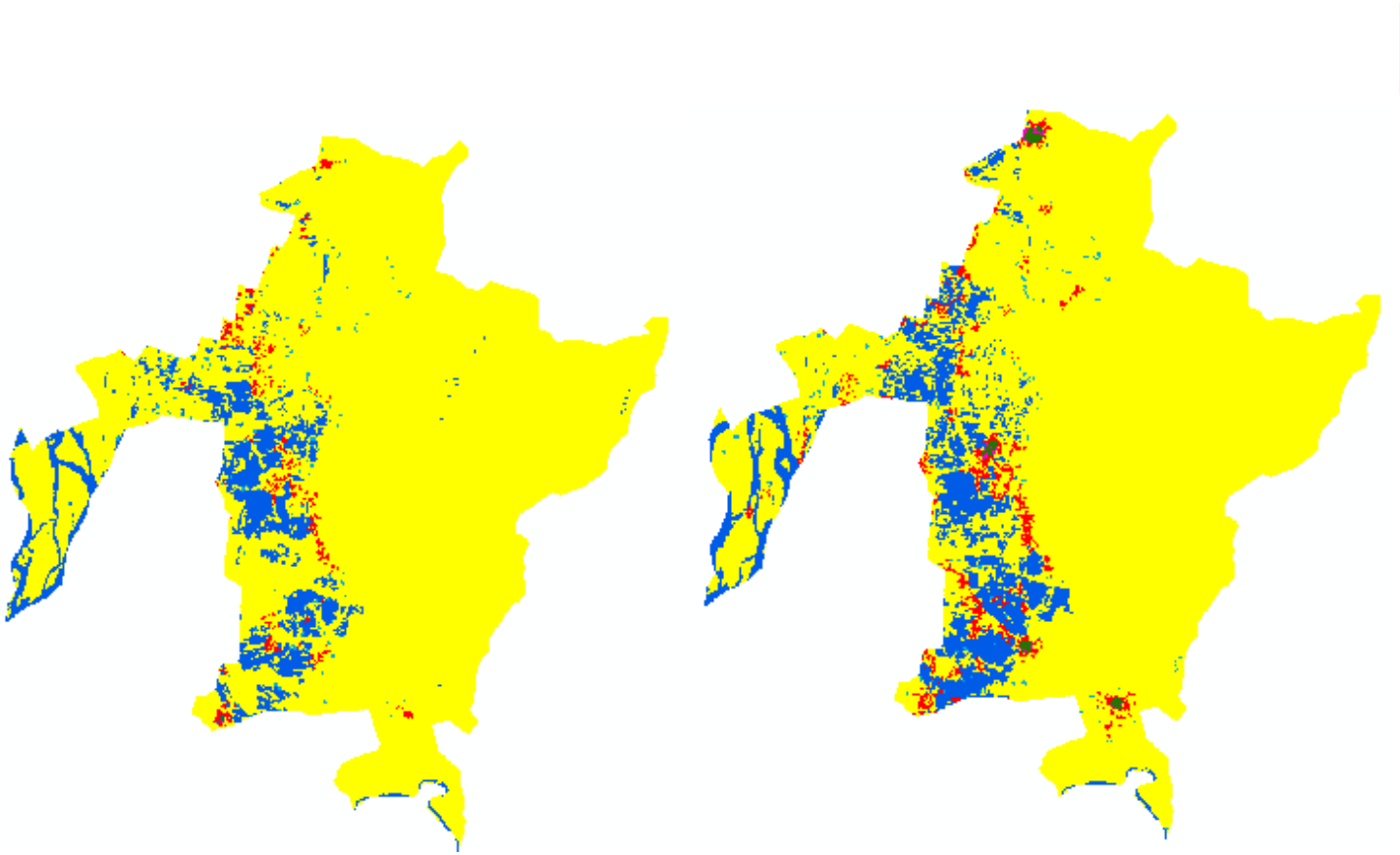


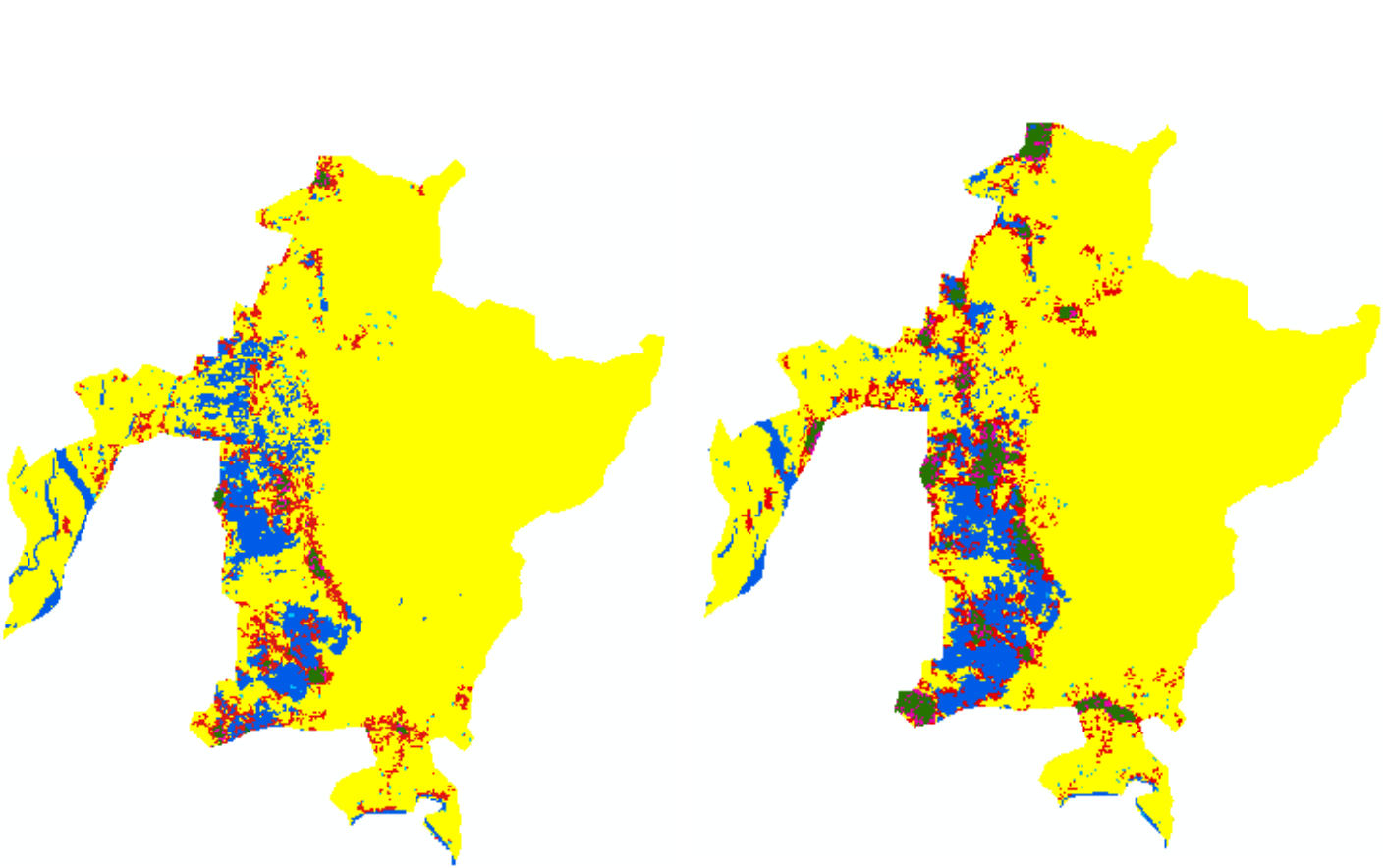
Patheingyi Township in 2010 and 2015

Classified map by using ArcGIS Software



Patheingyi Township in 2000 and 2005

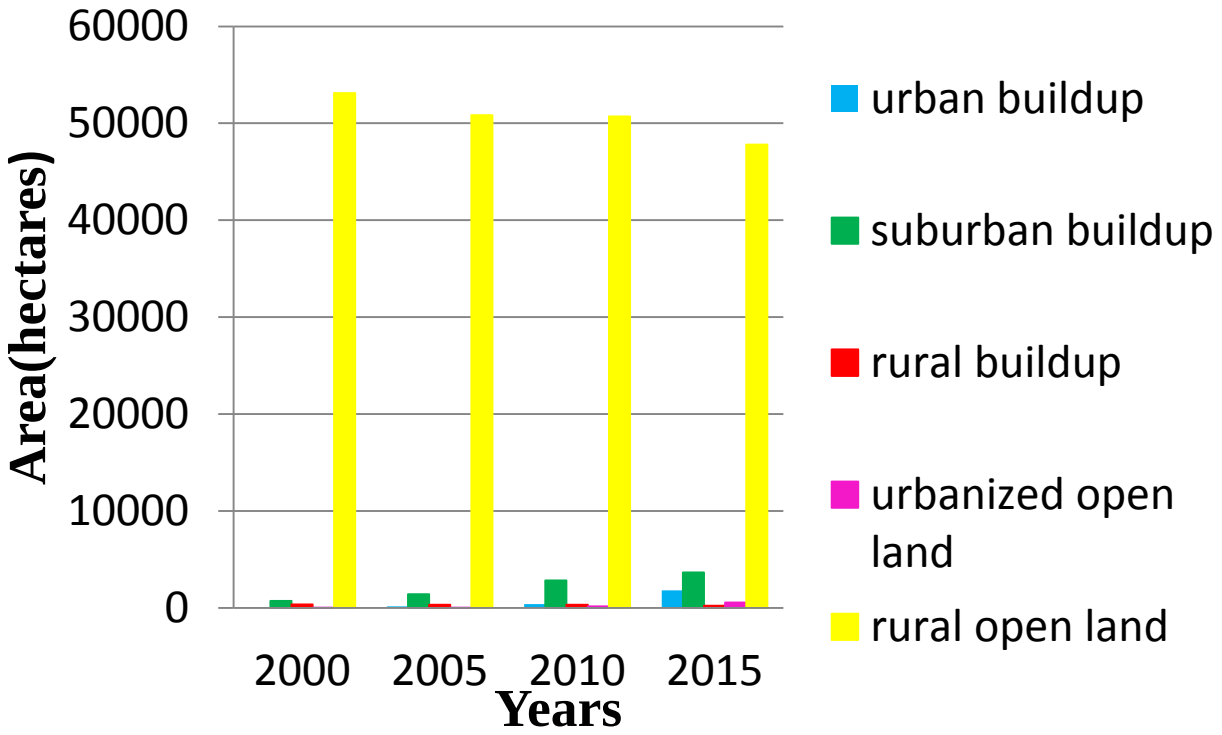
Cont'd



Patheingyi Township in 2010 and 2015

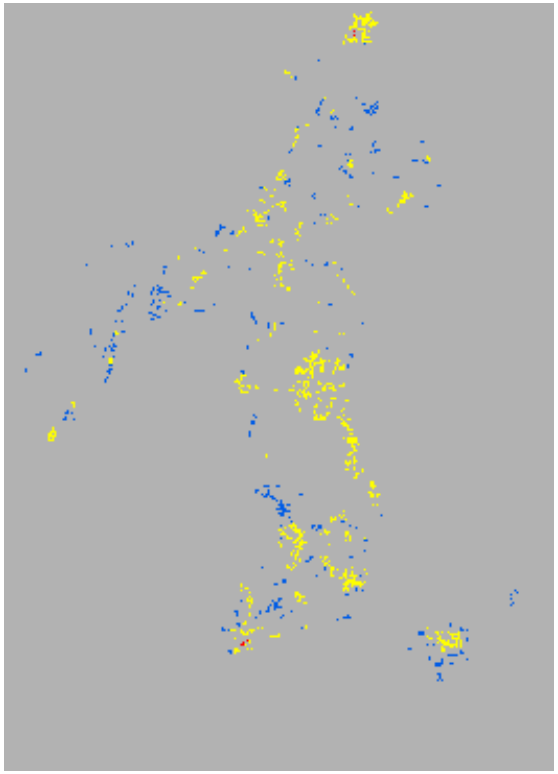
Area of Classified Maps

- Suburban buildup area is increased 1.28 times from 2010 to 2015 . During the same period, urbanized open land is increased by 600 hectares.

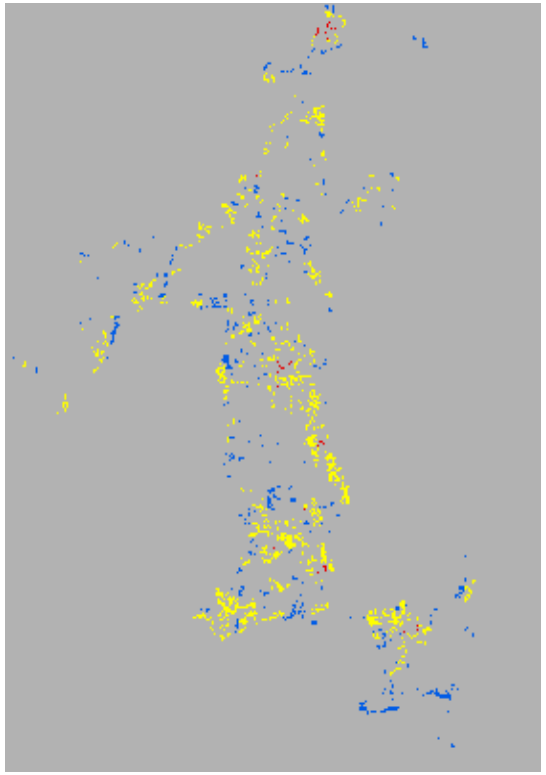


Urbanized Area of Patheingyi Township

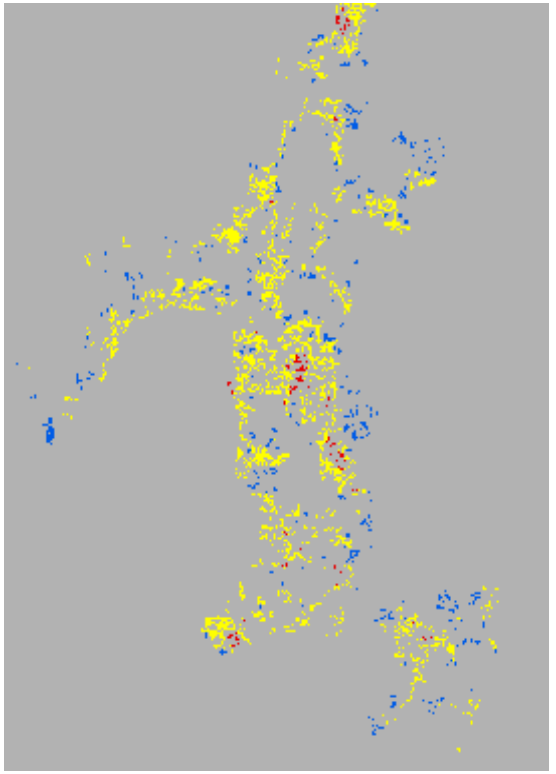
New Development Area



2000-2005



2005-2010



2010-2015

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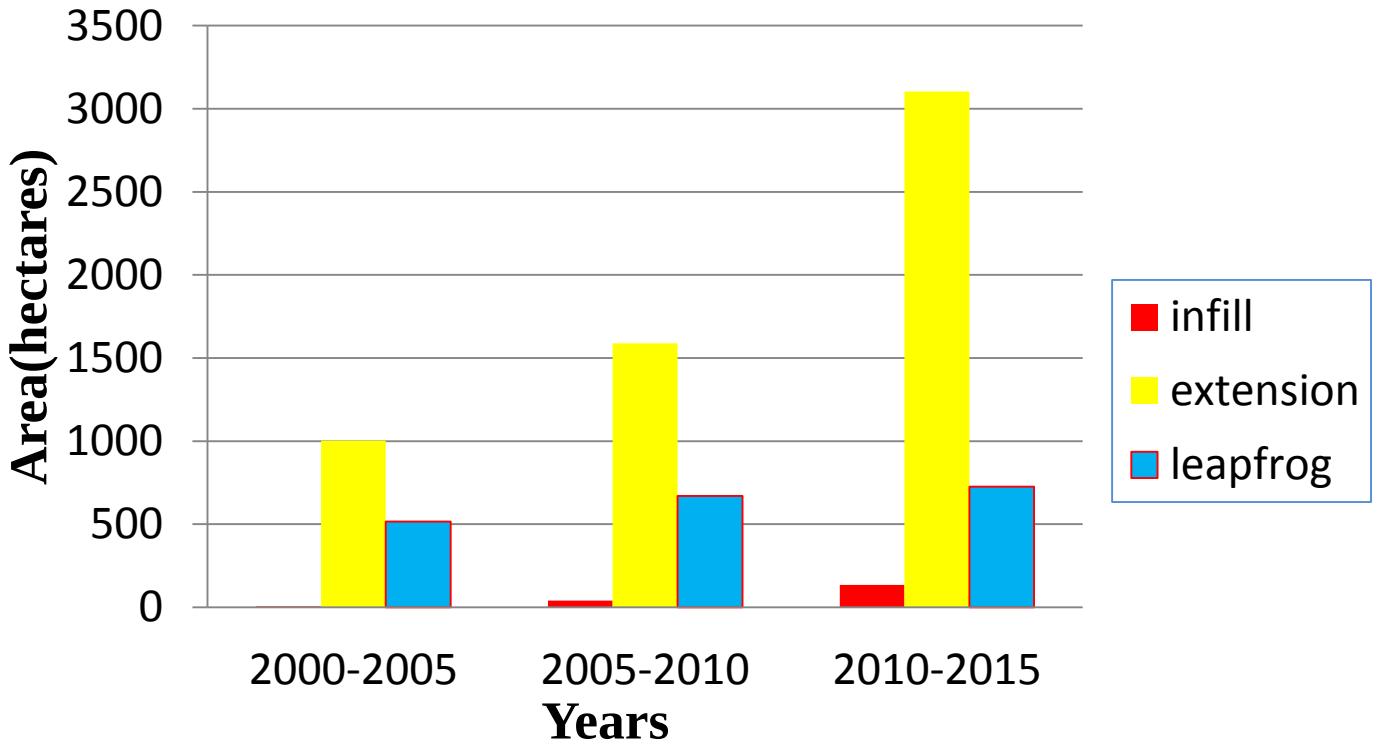
- From 2000 to 2015, increasing in the new development area could be attributed to extension that accounts for more than 71.47 % of new developments. Leapfrog 28.37 % and infill 0.16 % are contributed to new development area.



Urban Growth Areas of Patheingyi Township

Conclusion

- In the proposed system, random forest classifier is used to classify land use area; water, buildup and nonbuildup.
- In post classification, six classes; urban buildup,suburban buildup, rural buildup, urbanized open land, captured open land and water are classified with ArcGIS desktop 10.
- The system compares the changes of urbanized areas and new development areas of Patheingyi Township in a period

  (2000,2005,2010 and 2015).

Thank You