

# EXTRACTION OF INLAND *Nypa fruticans* (Nipa Palm) USING SUPPORT VECTOR MACHINE

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**ABSTRACT:** Mangroves are considered as one of the major habitats in coastal ecosystem, providing a lot of economic and ecological services in human society. *Nypa fruticans* (Nipa palm) is one of the important species of mangroves because of its versatility and uniqueness as halophytic palm. However, *nipas* are not only adaptable in saline areas, they can also managed to thrive away from the coastline depending on the favorable soil types available in the area. Because of this, mapping of this species are not limited alone in the near shore areas, but in areas where this species are present as well. The extraction process of *Nypa fruticans* were carried out using the available LiDAR data. Support Vector Machine (SVM) classification process was used to extract *nipas* in inland areas. The SVM classification process in mapping *Nypa fruticans* produced high accuracy of 95+%. The Support Vector Machine classification process to extract inland *nipas* was proven to be effective by utilizing different terrain derivatives from LiDAR data.

## 1. INTRODUCTION:

Mangroves are considered as one of the major habitats in coastal ecosystem, providing a lot of economic and ecological services in human society. Mangrove forests are differentiated in various forms of habits such as trees, shrubs, and palms. Typically, mangroves are adapted in harsh conditions of salinity, warm air, temperatures, changing tides, muddy, and oxygen depleted soil (<http://earthobservatory.nasa.gov/>). *Nypa fruticans* (Nipa palm) is one of the important species of mangroves and due to its adaptability in many circumstances, this species tend to occupy any space available depending on the favorable soil types available in the area. *Nipas* are widely used species by the local people and cutting off of this palm is very common in any areas. Some of the valuable goods of *nipas* are the sap which fermented into vinegar and alcohol, and the leaves that were used to weave useful products. The high demand of this palm tend to give problems in monitoring the density and location of the available area of this species. Due to the proximity of the area where this species is present, mapping of this species is difficult to achieve. Moreover, with the aid of advanced technology and the availability of remotely sensed data, *nipas* can be easily extracted and classified even in inland areas where this species are also present.

Light Detection and Ranging (LiDAR) mapping is one of the effective and accepted methods in generating high accuracy and projected maps. This remote sensing technique uses a radar sensors that project light pulses instead of radio waves and collects high resolution data (Carter et. al, 2012). The data collected using LiDAR method are used as datasets in generating raster layers needed in producing land cover maps of different features in various classification process. On the other hand, Support Vector Machine was proven to be one of the best classification algorithm used to generate resource maps.

SVM is a machine learning algorithms which utilizes and analyzed the unique characteristics and scientific patterns of chosen features or the given training samples to create new examples based on the probable similarities of the objects (Pradhan, 2012). Using remotely sensed data, study and monitoring of mangroves will be achieved accurately, rapidly, and cost-effective (Green et. al, 1998). Thus, by utilizing the available remotely sensed data, extracting of

inland *Nypa fruticans* will give ease to the locals to estimate and locate the areas of this mangroves away from the coastline.

## 2. OBJECTIVES:

The objective of this study is to extract inland *Nypa fruticans* in San Fabian, Pangasinan using LiDAR data and classified using Support Vector Machine.

## 3. MATERIALS AND METHODS

### 3.1 Datasets and Study Site

The study site is located in San Fabian, Pangasinan (Figure 1) with a total area of 4.05km<sup>2</sup>. The data used in this study are flight mission (Agno5P) of LiDAR data from the DREAM, Data Acquisition Component, University of the Philippines Diliman, Philippines.

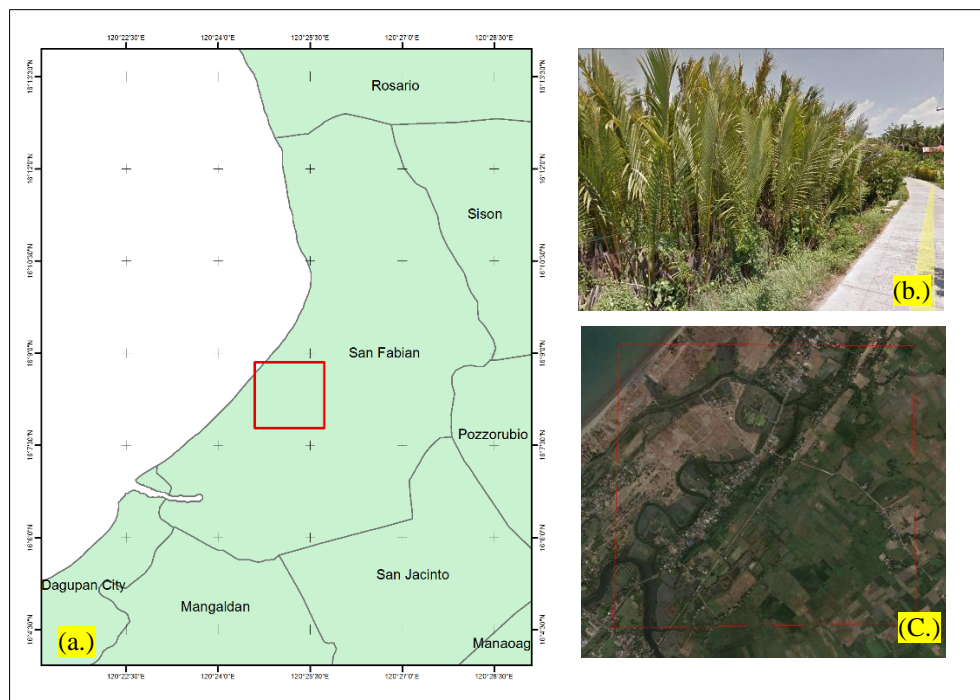


Figure 1. (a) study site, (b) samples of *Nypa fruticans*, (c) aerial view using Google Earth of San Fabian, Pangasinan.

### 3.2 Conceptual Framework of the Study

The methodology in this study includes the data processing, image classification using Support Vector Machine (SVM), field activities, and accuracy assessment. Figure 2 shows the conceptual framework of the study.

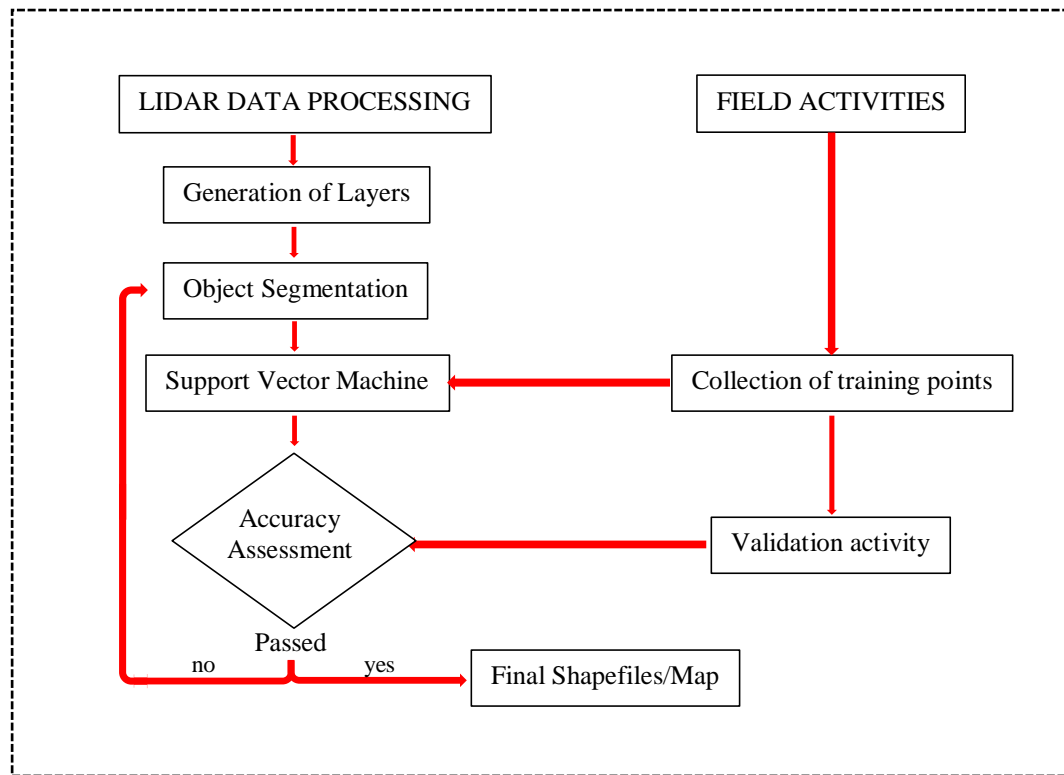


Figure 2. Conceptual framework of the methods used in the study.

### 3.3 Generation of Layers

LiDAR data were used to generate raster layers using different softwares like; LasTools, ArcGIS, and ENVI softwares. LasTools was used to produced Digital Surface Model (DSM), Digital Terrain Model (DTM), and Building Layer, and ENVI for Intensity Layer. In addition, nDSM, CHM, Slope, and Curvature were generated using ArcGIS software.

Table 1. Layers used in SVM classification process.

LAYER	DESCRIPTION
DSM and DTM	Digital Surface Model: Earth surface objects Digital Terrain Model: Earth surface without any objects
nDSM	DTM grid subtracted from the DSM grid to obtain the height of objects above the ground
Slope	Steepness of certain straight line.
Curvature	Degree to which a curve deviates from a straight line, or a curved surface deviates from a plane.
CHM	Canopy Height Model created by subtracting ground altitudes from canopy altitudes.
Building Layer	Layer generated using Lasgrid (LasTools) that has unique values for buildings or any infrastructures.
Intensity Layer	Reflectivity of the object struck by the laser pulse.

### 3.4 Segmentation and Pre- Classification Process

Classification process of the *Nypa fruticans* was carried out using the eCognition developer software. Layers generated were loaded in the software and performed using series of algorithms. Differentiation of low and high features were classified using multi-resolution segmentation to preliminarily extract the *nipas* as a vegetation class. Built-up or building objects were extracted using multi-threshold segmentation utilizing the building layer to filter the tall objects and to come up with a homogenous super objects of vegetation. Super objects of vegetation class were segmented using multi-resolution approach by putting higher weights for slope, CHM, and nDSM. Setting proper scale and

weights per raster layer is needed to accurately segment the objects. Trial and error method were commonly used to come up with a good segmentation process, however, by characterizing the growth pattern of *nipas*, setting of the scales and weights were simply carried out to obtain good segmentation. Table 3 shows the scaling and weighing of layers in the segmentation process.

Table 2. Parameters used in Multi-resolution segmentation.

Segmentation Settings	Weights and Scale
Image Layers	
Building Layer	0
CHM	5
Curvature	0
DSM	0
DTM	1
Intensity	1
nDSM	2
Slope	3
Scale Parameter	30
Composition of homogeneity criterion	
Shape	0.2
Compactness	0.8

Increasing the weights of the layer when calculating the heterogeneity degree used to decide whether pixels/objects are merged and zero value ignores the layer (<http://learningzone.rspoc.org.uk/>). The final result of the multi-threshold segmentation applying the weights and scales is shown in Table 2.

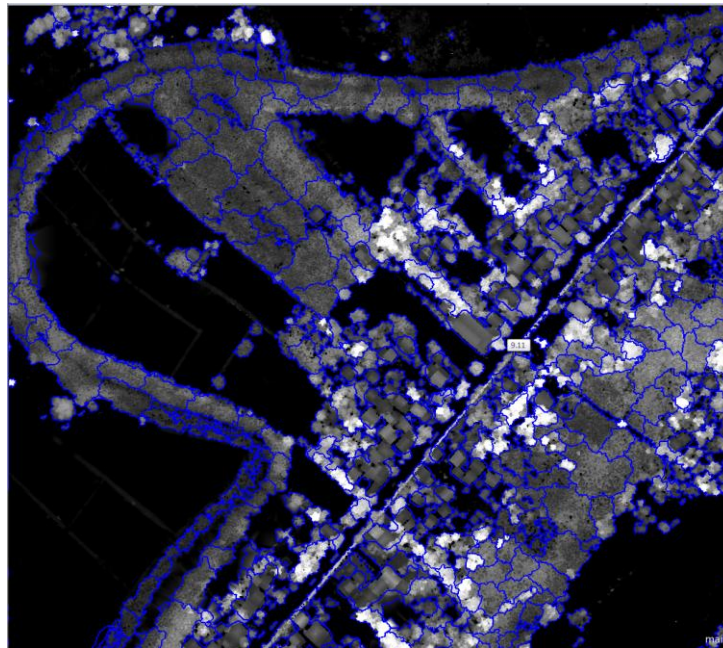


Figure 3. Image segmentation using multi-resolution.

### 3.5 Image Classification using Support Vector Machine (SVM)

Support Vector Machine was first introduced by Vapnik (1968) as a machine learning algorithm for classification and perform regression rules from the data that can be used to learn polynomial, radial basis function, and multi-layer perceptron as a classifier (Osuna 1997). SVM was said to be a competitive and best machine learning algorithms in

classifying high-dimensional data sets (Huang, 2002). Moreover, the automation of this classifier guaranteed best results. This classification process was used in extracting the inland *nipas* in the study.

A total of 60 training points (30 points per class of trees and *nipas*) were collected and used as sampling points for the SVM classification process. SVM classification process was applied in the segmented vegetation class to separate *nipas* from trees or vegetation. SEaTH (Separability and Thresholds) Algorithm was used to ease the selection process of proper features and layers that were used in the SVM classification process. SEaTH calculates the thresholds which allows the maximum separability of the sample objects or features (Nussbaum, 2006). After running SEaTH algorithm, 10 highest parameters were selected and applied in the SVM and performed classification process (Table 3).

Table 3. Threshold parameters calculated by SEaTH Algorithm

Features	Layers	SEaTH J Value
GLCM Homogeneity (All dir.)	Slope	1.77775
Standard Deviation	nDSM	1.72164
	DSM	1.70202
	CHM	1.69086
Mode (Minimum)	DSM	1.59394
Mean	DSM	1.55214
Standard Deviation Slope	Slope	1.49958
Mean	DTM	1.48238
Mode (Maximum)	nDSM	1.47711
Mean	nDSM	1.45365

## 4. RESULTS AND DISCUSSION

### 4.1 Segmentation and Pre-Classification Process

In segmentation process, proper weighing of layers and parameter scaling is very vital to produced homogenize objects. It was found out that utilizing the Canopy Height Model (CHM), DTM, nDSM, Intensity, and Slope, area of *nipas* can be segmented accurately with proper weighing. On the other hand, Shape and Compactness also affect the precision and smoothness of the segmented objects. Setting up low value in Shape while high value for the compactness will aid to separate trees which sprouted in the middle of the *nipas*. Figure 4 shows the segmented vegetation objects using multi-resolution segmenation.

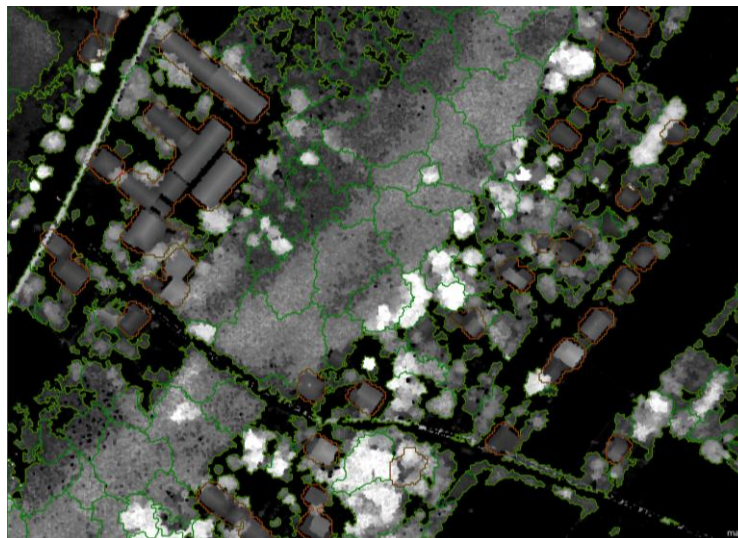


Figure 4. Image segmentation of trees using multi-resolution.



## 4.2 Image classification for Support Vector Machine.

Application of SEaTH algorithm in selecting proper features and layers to be used, results showed that the algorithm could help to reduce the difficulties in setting the features that needed in SVM classification process. It was also observed that Slope, nDSM, DSM, and DTM layers are effective in extracting inland *nipas* from the other vegetation. Figure 5 shows the result of the classification process of SVM and SEaTH algorithm.

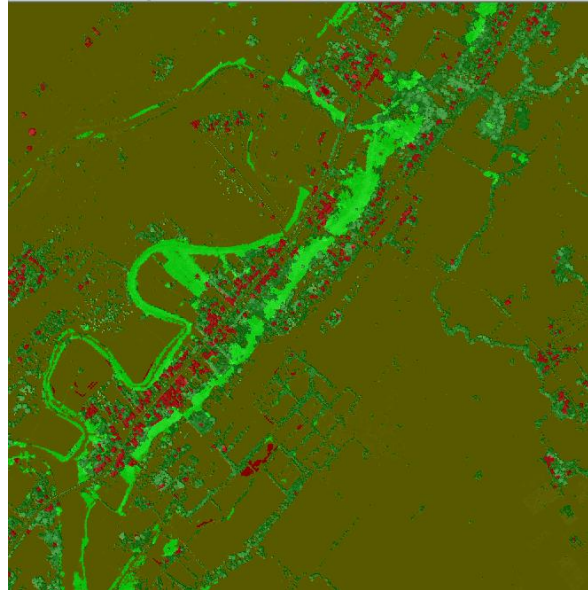


Figure 5 shows the result of the classification process using Support Vector Machine and SEaTH Algorithm.

## 4.3 Accuracy Assessment

Accuracy assessment was carried out to evaluate the performance of the SVM classifier. A set of 60 points (30 points per class) were validated to generate classified samples for the accuracy assessment. It was observed that the extraction process for the *nipas* obtained high accuracy of 97.9% with a Kappa coefficient of 95%. Moreover, the Kappa coefficient per class obtained by *nipas* has 91%, while 100% for the trees or other vegetation.

## 5. CONCLUSION

Weighing of layers and appropriate scales are important to have an accurate segmented objects. Support Vector Machine was proven to be effective in extracting inland *Nypa fruticans* and SEaTH algorithm have a significant effect in the classification process. The study shows that using Support Vector Machine, an accuracy of 95+ can be obtained using LiDAR datasets and it may varies depending on to the layers that will be used.

## 6. ACKNOWLEDGEMENT

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