PERFORMANCE OF LOGISTIC REGRESSION MODEL FOR SPATIAL ANALYSIS (CASE:DEFORESTATION PREDICTION IN CIKEPUH WILDLIFE RESERVE AND CIBANTENG NATURAL RESERVE)

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ABSTRACT

Cikepuh Wildlife Reserve and Cibanteng Natural Reserve area were established in 1973 and 1925, respectively. They have been facing complex problem caused by land use changed, deforestation, illegal hunting, forest, and fire. The study focused on what factors have affected deforestation by considering some common driving forces (altitude, slope, aspect, distance from river, road and coast, and population center), then the factors were analyzed using logistic regression. Independent variables are classified into two binary categories, namely 0 and 1 based on expert judgment. All variables of independent and dependent variables are filled in the squared-shaped polygon (PVC) as one attribute, included calculation result of logistic regression.

The overall accuracy of spatial prediction is only 56 %. It is lower than non-spatial accuracy which is 91%. The prediction result showed that deforestation at the area located within road distance less than 1 km tends to deforest 3 times compare the distance greater or equal to 1 km. The smallest possibility of deforestation occurrence was contributed by predictor distance 1 km from river, and almost has no effect to deforested occurrence. Regression logistic equation in this study could be used to predict deforestation significantly.

Introduction

Cikepuh Wildlife Reserve is one of conservation area located in the southern of Sukabumi District, West Java Province, Indonesia. (Fig. 1). In the northern part of Cikepuh Wildlife Reserve is bordered by Cibanteng Natural Reserve. Cibanteng Natural Reserve is characterized by forest and natural grass land, that is suitable for wildlife habitat. Unfortunately, Cikepuh Wildlife Reserve had deforested of about 80% (Sahardjo, 2000). In this study a logistic regression model is proposed as an effective framework for the modeling prediction of the land use/land cover change associated with the spatial pattern and rates of deforestation.

The specific objectives are: (1) to quantify the forest cover and deforestation, (2) to quantify the contribution of each deforestation driving factors, and (3) to elaborate spatial projection of future trends of deforestation based on possibility of deforestation as the result of logistic regression as the spatial pattern by regression model formulation.

Hypothesis of the study is at least one of independent variables such as distance from river road, shore line and center of population, altitude, aspect, or slope can be used for predicting deforestation by the equation of logistic regression.

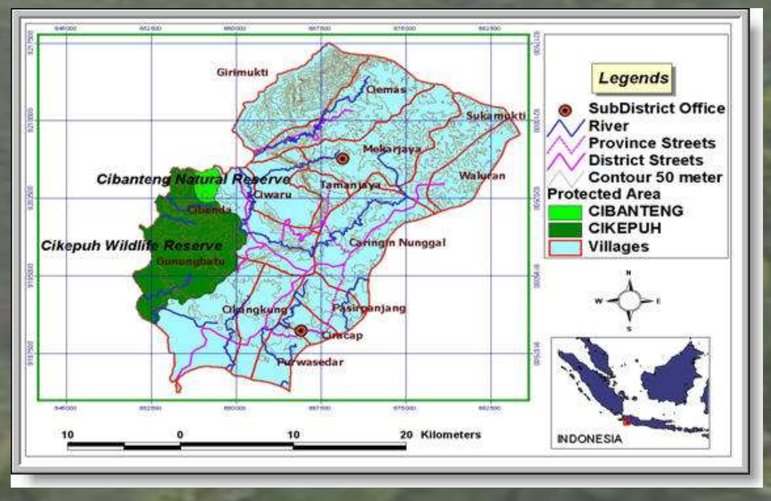

Fig. 2. Location of study area

Materials and Method

Data sources:

(1). Time series of Landsat TM (path/row : 122/65), acquisition date on Nov. 9th, 1990, July 28th, 1997, May12th 2001

(2). Topographic Map, from SRTM (Shuttle Radar Topographic Mission) (http://glcf.umiacs.umd.edu/index.shtml) with acquisition data 2000

(3). Digital Map in the form of Shape file from Center for Environmental Research & Planning Agency of Forestry Department

(4). Demographic and socio-economic data, which is collected from BPS (Bureau of Statistical Center) Sukabumi Province and Head Office Jakarta

Software:

ERDAS Imagine and CART, See5 (C5), ArcView 3.3., Statistic Program

Data development :

a. Land-use change analysis 1990 – 2001 (Fig. 2)

b. Categorization and develop binary maps of each factors (Table 1) & presented in map (Fig. 3)

c. Running the model (Equation 1) & create the prediction map (Fig.4)

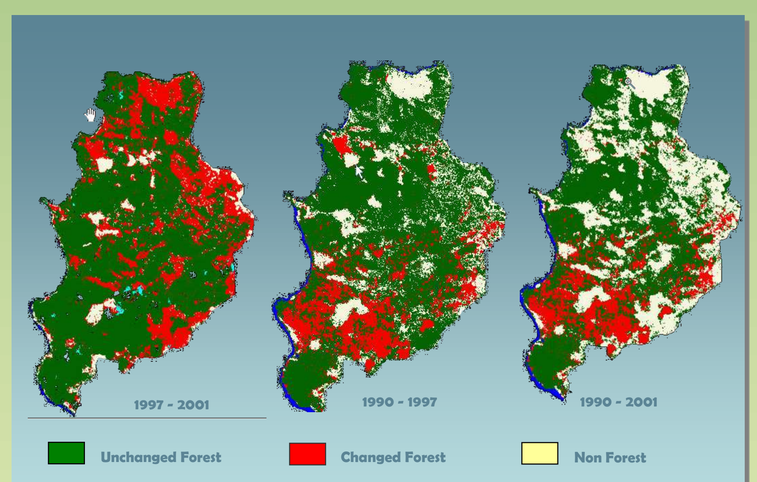

Fig. 2. Land cover classification and changed analysis

Table 1. Binary data and categorization of variables contributed to deforestation

Variable	Symbol	Value	Description
Forest - Deforestation	Y	0	Forest
		1	Deforestation
Elevation/Altitude	X_1	0	≥ 250 m
		1	< 250 m
Distance from population centers	X_3	0	≥ 10 km
		1	< 10 km
Distance from Shoreline	X_4	0	≥ 1 km
		1	< 1 km
Slope	X_5	0	≥ 25 - 90 degree
		1	< 0 – 25 degree
Distance from Road	X_6	0	≥ 1 km
		1	< 1 km
Distance from River	X_7	0	≥ 1 km
		1	< 1 km

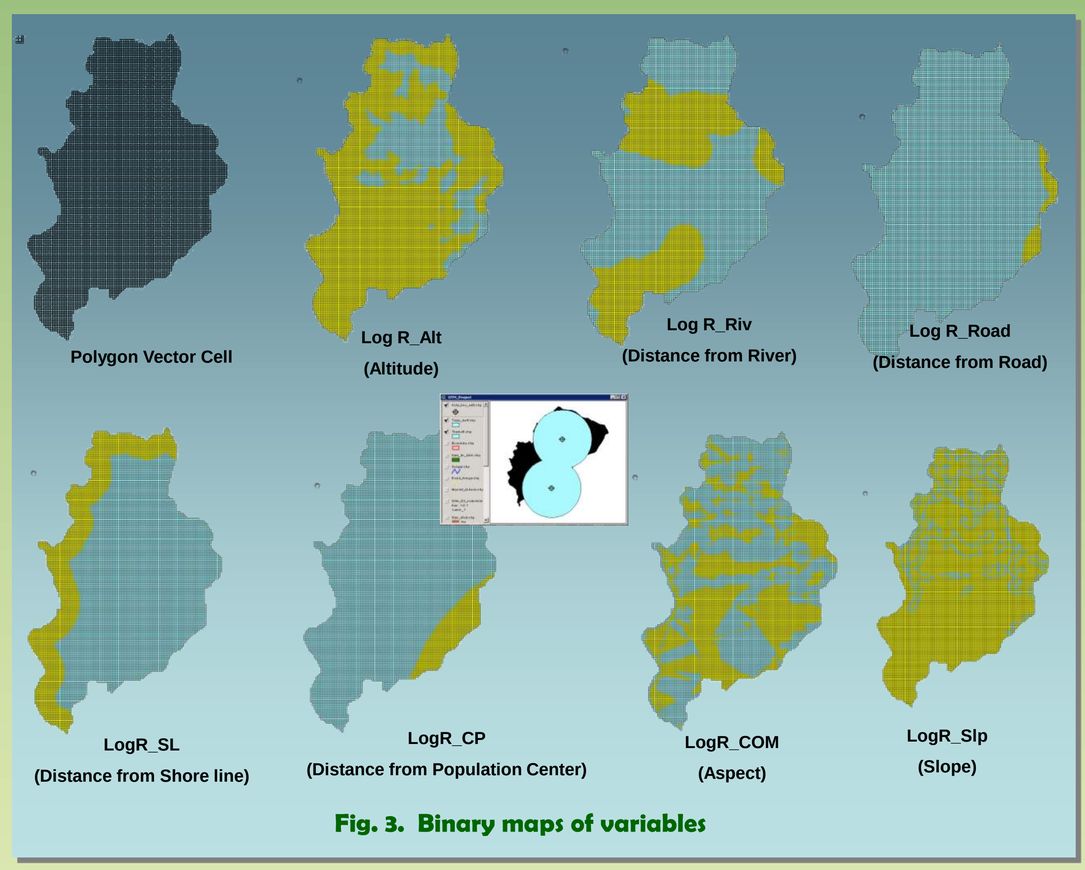

Fig. 3. Binary maps of variables

Results and Discussion

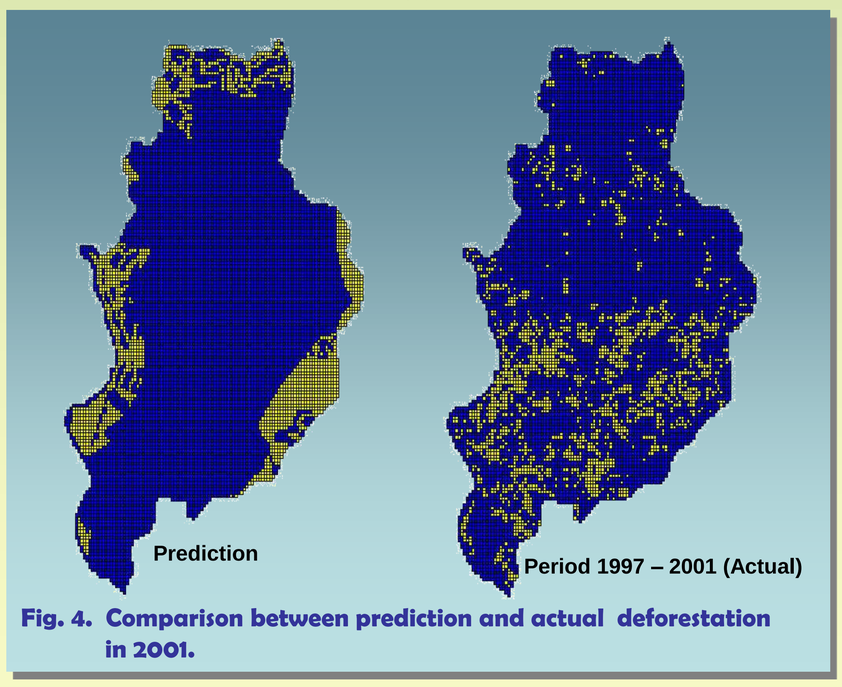

Fig. 4. Comparison between prediction and actual deforestation in 2001.

$$\hat{Y}_i = Prob\,(Deforestation) = \frac{e^{-0.238+LogR\_Riv(-0.232)+LogR\_Road(1.130)+LogR\_SL(0.348)+LogR\_CP(0.354)+LogR\_COM(0.082)+LogR\_SLP(-0.150)}}{1+e^{-0.238+LogR\_Riv(-0.232)+LogR\_Road(1.130)+LogR\_SL(0.348)+LogR\_CP(0.354)+LogR\_COM(0.082)+LogR\_SLP(-0.150)}}$$

Equation 1. Result of Logistic Linear

Based on the prediction model of about 18.4% of deforested pixel and 86.1% of unchanged pixels are classified correctly. However the overall accuracy is only 56.8%. This is due to the fact that road distribution was not completely available, especially road within the reserve. Further analysis showed that center of population (LogR_CP), shore line (LogR_SL) less than 1 km, distance from river less than 1 km (LogR_Riv), and distance from existing road less than 1 km (LogR_road) contribution to deforestation is approximately 7.4 %, 25%, 38.9% and 2.7%, respectively.

Regardless the spatial distribution, the magnitude of deforestation can be predicted accurately. During the period 1990 – 1997 the actual forest loss is about 1434 ha compare to the prediction model is 1314 ha. It can be said that the prediction model has non spatial accuracy of about 91.63% .

As conclusion, all independent variables except altitude can be used to predict deforestation, and have a good-fit for the model of logistic regression and its equation.

Conclusion

- **Deforestation of Cikepuh wildlife reserve and Cibanteng natural reserve area during the period of 1990-1997 and 1997 – 2001 is about 2071 ha and 1314 ha, respectively**
- **The spatial and non spatial accuracy of the model is 56.8% and 91.63 %, respectively.**
- **Variables of distance from population center, distance from river, distance from shore line, distance from road and slope can be used for deforestation prediction**
- **Odd ratio, in this study is showing that distance less than 1 km tends to deforested occurrence 3 times than distance greater or equal 1 km from existing road. The smallest possibility of deforestation occurrence was contributed by predictor distance 1 km from river.**

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