Chapter 113
Spatial Model Approach for Deforestation:
Case Study in Java Island, Indonesia

Lilik B. Prasetyo
Bogor Agriculture University, Indonesia

Chandra Irawadi Wijaya
Bogor Agriculture University, Indonesia

Yudi Setiawan
Bogor Agriculture University, Indonesia

ABSTRACT

Java is very densely populated since it is inhabited by more than 60% of the total population of Indonesia. Based on data from the Ministry of Forestry, forest loss between 2000-2005 in Java was about 800,000 hectares. Regardless of the debate on whether the different methodologies of forest inventory applied in 2005 have resulted in an underestimation of the figure of forest loss or not, the decrease of forest cover in Java is obvious and needs immediate response. Spatial modeling of the deforestation will assist the policy makers in understanding this process and in taking it into consideration, when decisions are made on the issue. Moreover, the results can be used as data input to solve environmental problems resulting from deforestation. The authors of this chapter modeled the deforestation in Java by using logistic regression. Percentage of deforested area was considered as the response variable, whilst biophysical and socioeconomic factors, that explain the current spatial pattern in deforestation, were assigned as explanatory variables. Furthermore, the authors predicted the future deforestation process, and then, for the case of Java, it was validated with the actual deforestation derived from MODIS satellite imageries from 2000 to 2008. Results of the study showed that the impacts of population density, road density, and slope are significant. Population density and road density have negative impacts on deforestation, while slope has positive impact. Deforestation on Java Island tends to occur in remote areas with limited access, low density population and relatively steep slopes. Implication of the model is that the government should pay more attention to remote rural areas and develop good access to accelerate and create alternative non agricultural jobs in order to reduce pressure on the forest.

DOI: 10.4018/978-1-4666-2038-4.ch113

1. INTRODUCTION

Like other developing countries, most of government and community income in Indonesia still depend on natural resources. As a result natural forest resources have been under great pressure of conversion. Based on FAO (2005)the rate of natural forest conversion in Indonesia is about 1.2% per year. This figure is higher than deforestation in Brazil (0.4%) and RD Congo (0.4%). Based on MOF RI (2007) total conversion of forest in the 5 biggest islands of Indonesia was, during 2000 – 2005, about 1.9 million hectares and Sumatra & Kalimantan were the biggest contributors. Deforestation relates to many factors, e.g. population growth (Palo, 1994), forest logging (Kummer, 1991), shifting cultivation (Thapa & Weber, 1990; MOF RI, 2007), illegal logging (MOF RI, 2007), resettlement (Hurst, 1990), road construction (Hirsch, 1987; Geist & Lambin, 2001) and Krutilla *et al*. (1996), international debt (Kahn & McDonald, 1994), and policy failure by government (Repetto & Gillis, 1988).

There are many publications pointing out that population increase will affect land use changes (Ramankutty et al., 2002). Angelsen & Kaimowitz (1999) argued that increased population growth leads to increase of demand for forest land and resources, and furthermore, the high rates of deforestation will drive to poverty. The connection between population growth and the rate of deforestation is also pointed out by Zhang et al. (2000). He stated that population growth in China is the main factor contributing to the loss of natural forests. Studies from Brazil (Andersen, 1996), Mexico (Barbier & Burgess, 1996), and Thailand (Cropper *et al*., 1997) also gave similar results. However, Sunderlin & Resosudarmo (1996) pointed out that the impact of human populations on the deforestation in Indonesia is site-specific.

So far, analyses of deforestation are based more on numerical statistical data and less on consideration of spatial context, whilst, in fact, it is very important to assist policy makers in understanding the process and take it into consideration, when decisions are made. Important data on the rate and spatial distribution of deforestation have been provided by the analysis of remote sensing images (DeFries *et al*., 2000). Furthermore, Lambin (2001) and Angelsen & Kaimowitz (1999) pointed out, that other researchers had studied deforestation at detailed scales by identifying the causes and underlying driving factors of the processes leading to deforestation. These models make an important contribution to the integrated analysis of the different deforestation trajectories in their environmental and socio-economic context.

Land-use and land cover change analysis in Java have been investigated by Verburg *et al*. (1999). They have predicted that land use change will especially occur in the lowland areas, either directly through construction or indirectly through the demand for higher value crops. The upland areas will stay primarily rural. The models were developed based on rough grid spatial data equal to 40 km x 40 km (1,600 km2) derived from agricultural surveys by the Central Bureau of Statistics and coupled with provincial forest cover data.

The objective of this study is to illustrate possible application of spatial modeling for deforestation in Java by using available forest cover data derived from remote sensing data and social economical data derived from village surveys (Potensi Desa/PODES), which were mapped on 10 km x 10 km grid spatial data.

2. METHODOLOGY

2.1 Datasets, Data Preparation and Statistical Analysis

In order to analyze spatial patterns of deforestation and make the prediction on deforested areas with a probability of conversion in the future, several datasets were used (Table 1). The information on forest cover in Java & Sulawesi was obtained from datasets of the land use map of Department of