Chapter 10
Modeling Land-Use and Biodiversity in Northern Thailand

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ABSTRACT

Rapid deforestation has occurred in northern Thailand over the last few decades, and it is expected to continue. Besides deforestation, climate change has become a global threat to biodiversity in recent years and in the future. The government has implemented conservation policies aimed at maintaining a forest cover of 50% or more and has been promoting agribusiness, forestry, and tourism development in the region. The goal of this chapter was to analyze the likely effects of various directions of development on the region. Specific objectives were to: (1) forecast land-use change and land-use patterns across the region based on trend, integrated-management, and conservation-oriented scenarios, (2) analyze the consequences of deforestation and climate change for biodiversity, and (3) identify areas most susceptible to future deforestation and high biodiversity loss. The chapter combined a dynamic land-use change model (Dyna-CLUE) with a model for biodiversity assessment (GLOBIO3). The Dyna-CLUE model was used to determine the spatial patterns of land-use change for the three scenarios, viz trend, integrated management, and conservation oriented. The methodology developed for the Global Biodiversity Assessment Model framework (GLOBIO3) was used to estimate biodiversity intactness expressed as the remaining relative mean species abundance (MSA) of the original species relative to their abundance in the primary vegetation. The results revealed that forest cover in 2050 would mainly persist in the West and upper North of the region, which is rugged and not easily accessible. In contrast, the highest deforestation was expected to occur in the lower north. MSA values decreased from 0.52

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in 2002 to 0.45, 0.46 and 0.48, respectively, for the three scenarios in 2050. The expected MSA values were lower than the predefined target of 30% at outside protected areas for all land use scenarios. The lowest value is found for the trend scenario (20.8%). The expected MSA for trend scenario is below the predefined target of 70% due to high habitat loss and severe fragmentation from road development in the future. Nevertheless, the MSA values for integrated and conservation-oriented scenarios nearly meet the representation goal. Based on the model outcomes, conservation measures were recommended to minimize the impacts of deforestation on biodiversity. The model results indicated that only establishing a fixed percentage of forest was not efficient in conserving biodiversity. Measures aimed at the conservation of locations with high biodiversity values, limited fragmentation, and careful consideration of road expansion in pristine forest areas may be more efficient to achieve biodiversity conservation.

1. INTRODUCTION

Deforestation and land-use change are critical threats to biodiversity in Southeast Asia (Fox & Vogler, 2005). The Food and Agriculture Organization of the United Nations (FAO, 2010) recently announced that the world's total forest area is just over four billion hectares or 31% of the total land area. Deforestation, mainly the conversion of tropical forests to agricultural land, has decreased over the past ten years but continues at an alarmingly high rate in many countries. Globally, around 13 million hectares of forests were converted to other uses or lost through natural causes each year between 2000 and 2010 as compared to around 16 million hectares per year during the 1990s. South America and Africa had the highest net annual loss of forests in 2000-2010, with four and 3.4 million hectares respectively. Asia, on the other hand, registered a net gain of some 2.2 million hectares annually in the last decade, mainly because of large-scale afforestation programs in China and Vietnam, which have expanded their forest area by a total of close to four million hectares annually in the last five years. However, conversion of forested lands to other uses continued at high rates in many countries.

Forest loss in Thailand was ranked the highest of all countries in the Greater Mekong sub-region and as fourth in the top ten of tropical countries in terms of annual rate of loss in 1995 (CFAN, 2005). According to Charuphat (2000), forest cover in Thailand declined from 53% of the country's area in 1961 to approximately 25% in 1998. Deforestation in Thailand is mainly caused by commercial logging of primary forest, agribusiness, and urban development, driven by ongoing population growth (Panayotou & Sungsuwan, 1989) and the national development strategy (Delang, 2002) to gain foreign income. Cropper *et al.* (1996) indicated that road development and population growth explain about 70% of the deforestation that occurred in Thailand between 1976 and 1989. During this period, about 1.2 million new agricultural households and about 17,000 km of roads were added in northern and northeast Thailand.

Deforestation has been a concern for policy makers as it has been listed as the most important environmental issue in the Kingdom of Thailand in the last ten years (ONEP, 2006). In 1989, the Thai government declared the closure of commercial logging concessions as part of its change in strategy for national development. In addition, the Royal Thai Government (RTG) has implemented two measures to avoid further deforestation and increase forest cover, namely the establishment of a protected areas network and reforestation, respectively (Trisurat, 2007). Nevertheless, the latest assessments based on new and improved methods of measuring and classifying forest cover show that the remaining forest cover slightly decreased between 2000 and