LAND USE AND LAND COVER CHANGE FOR SOUTH EAST ASIA. A CASE STUDY IN TAMDAO NATIONAL PARK

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1. INTRODUCTION

Land use change is one of the major processes of global environmental change affecting future access to and conservation of natural resources, including biodiversity. The study of land use change requires application of new technologies and the interdisciplinary analysis of the human dimensions of global change, interactions with the biophysical environment. An improved understanding of the processes giving rise to land-use change dynamics in combination with assessments of near-future land use strategy and the identification of tendency of change will help to improve natural resource management.

Tamdao National Park (TDNP) located in a territory of 3 provinces: Vinh Phuc, Thai Nguyen and Tuyen Quang with a very rich forest resources was established to preserve biodiversity and promote natural resources management neglected for many years due to some circumstances. Growing human population, over exploitation of forests and unscientific landuse practices causing degradation of biodiversity, ecosystem unbalance, soil erosion, land slides and increasing run off. A case study in the Park has the very aim (i) to monitor the land use land cover dynamics of the park for the period of 24 years from 1975 through 1992 to 1999 using remotely sensed data and GIS technique; (ii) to monitor impact of the establishment of the park on forest resources and biodiversity, and also (iii) to draw an tendency of land use land cover change before and after the Park established. Specifically the study has the following objectives:

- ✓ Determine the total amount of land use land cover change from 1975 to 1999 and the rate of deforestation over this time period;
- ✓ Determine the driving forces, leading to the changes in land use, land cover and analyze these forces.

2. METHODS

The methodology consisted of the study and analysis of remote sensing data of the year 1975 (Landsat MSS), 1992 (Landsat TM) and 1999 (Landsat ETM+), and the collection of ancillary physical and socio-economical data.

Identification of different land use land cover types were done by unsupervised and supervised classification modules of ERDAS IMAGINE 8.4. Firstly, the satellite images were

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geocoded, enhanced and then classified using isodata algorithm. Ground truth survey was carried out to develop training set for supervised classification. Results of image classification verified in the fields to create land use land cover map of the study area.

Along with land use land cover map of different times, various ancillary data were collected and converted into ***GIS format by digitization and data entry.***

Data analysis: Overlay land use/land cover maps of three dates to produce coincidence Matrix and land use change map which then overlaid with various thematic maps to generate statistical data from the land cover. Results of this step would also be a transition process occurring in the area during the study period.

Identifying driving forces: Based on the results of multiple analysis on changes in land use/land cover identifying driving forces leading to these changes. Based on data collected in the study area try to analyze and assess these forces in the context of economic development of the country.

3. DESCRIPTION OF THE STUDY AREA

TDNP is located in a territory with 3 provinces: Vinh Phuc, Thai Nguyen and Tuyen Quang. The center of the TDNP is located 80 km northwest of Hanoi and 20 km north of the town of Vinh Yen. The geographical coordinate of the TDNP is: $21^0$21' - $21^0$42' N and $105^0$23' - $105^0$44' E

The total population in the Tamdao in 1999 is about 95,486 persons. The area under study is relatively sparsely populated and unevenly distributed with an average population density of 161 persons per sq. km. Infrastructure in the TDNP is poor, connected to Hanoi by National Road No. 2.

The TDNP lies in the zone with a humid tropical mountain climate. Average temperature is about 22 ^{0}C and annual average rainfall is about 1900 mm.

Forests in TD can be classified under tropical forest with a predominance of species of Dipterocarpaceae and Lauraceae. However, in the TD, for the high degree of differentiation of humidity and altitude there is very diverse flora, including not only tropical and sub-tropical species but also species of a moderate zone. According to the FIPI[5], there are 6 Gymnosperm species in the TD. They are Amentotaxus sp., Fokienia hodginsi, Yen Tu pinus (Podocarpus brevifolius) and Podocarpus fleuryi. Fokienia hodginsi is a moderate zone species distributed in TD at an altitude of 1000m and higher. In Dai Tu district (Thai Nguyen province) at altitude of 1000m, Fokienia hodginsi grows in large patches, in combination with other broad-leaved species. In the TDNP there are the following forest types:

+ Evergreen tropical rain forest;
+ Evergreen sub-tropical rain forest in medium mountain;
+ "Short" forest at the top mountain;
+ Secondary forest after overlogging;
+ Regenerating forest;
+ Forest plantation.

Tamdao National Park was officially established in January of 1995, its former organization being a natural conservation area. The National Park is divided in two parts, one is under strict protection (over 400m AMSL) and another for ecological regeneration (distributed between 400m and 100m AMSL).

[5] Research of flora in Tamdao for technical Feasibility report 1993

4. RESULTS

Based on land use, land cover maps derived from classifying satellite images of Landsat ETM+, here we have the following land use/land cover status of the study area and its changes:

Table 1. Land use/land cover change in Tamdao National Park from 1975 to 1999

Land use/land cover	Date			Change 1975 - 1992		Change 1992 - 1999		Change 1975 - 1999	
	1975	1992	1999	ha	%	ha	%	ha	%
1. Natural forest	31674.1	26516.6	28666.4	-5157.5	-16.3	2149.8	8.1	-3007.7	-9.5
- Old forest	24,601.0	19,746.7	15,231.1	-4,854.3	-19.7	-4,515.6	-22.9	-9,369.9	-38.1
-Secondary forest	7,073.1	6,769.9	13,435.3	-303.2	-4.3	6,665.4	98.5	6,362.2	89.9
2. Open/bare land	9,827.2	13,554.9	12,826.5	3,727.7	37.9	-728.4	-5.4	2,999.3	30.5
3. Agriculture	1,624.1	3,053.9	1,632.5	1,429.8	88.0	-1,421.4	-46.5	8.4	0.5
Total	43,125.4	43,125.4	43,125.4	0	0.0	0	0.0	0	0.0

The results of the case study had revealed that during the study period from 1975 to 1999 the area under forest (including both old natural forest and secondary forest) had decreased by 9.5% (representing an 38.1% decrease in old natural forest and 89.9% increase in secondary forest areas). The area under open / bare land had increased by 30.5%, while the agriculture land remained almost unchanged (had increased by 0.5% only) during this period.

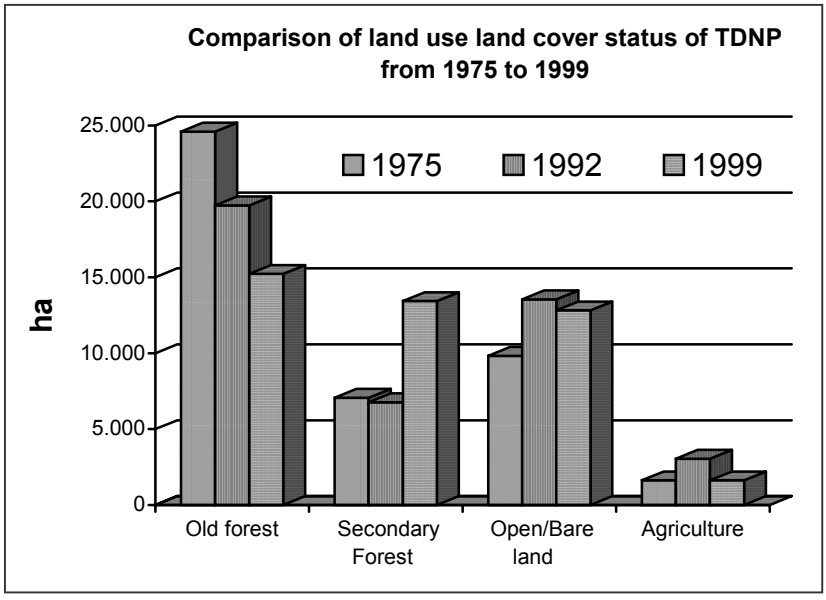

Figure 1. Comparison of land use land cover status of TDNP from 1975 to 1999

However, the year 1992 - one year before the feasibility study for establishing the national park was prepared in 1993 - was some kind of turning point in the dynamics of a land use pattern in the study area. It can be clearly seen in the table above, while in the period from 1975 to 1992 natural forest had decreased by 16.3%, it had increased in the next period from 1992 to 1999 by 8.1% thanks to significant increase in secondary forest (totally by 98.5%). In terms of open / bare land and agriculture land, we can observe a significant

increase in the sub-period from 1975 to 1992 (by 379% and 88.0% respectively) and decrease in the next one (by 5.4% and 46.5% respectively) having led to overall less significant increase in these landuses for whole study period from 1975 to 1999.

Study has integrated these results with spatially explicit socio-economic and biophysical data in a GIS framework to model the driving forces of these changes. Changes are most likely to be changes in management policies and legislation that have been recently introduced in Vietnam. Amongst these are the Land Law (1993), Code on Forest Protection and Development (1991), and Forest Lands Allocation Policy. The positive influence of the effective management measures and policies has lead to overall increase in forest areas and decrease in open / bare lands.

On the other hand, during the same period parts of the study area had lost some forest cover due to activities directly related to the human activities, mainly illegal logging and firewood collecting. This means that there need more strict measures for protecting the forest resources within the National Park including propaganda activities among the local people to involve them in protecting the forests from violation.

The approach of linking remote sensing based estimates of land cover change with socio-economic and biophysical data is critical for judicious natural resource management and long-term planning in Vietnam.

5. REFERENCE

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