

# Dynamics of Land cover-Land use in Different Communities of Vietnam Northern Mountain Region: An Implication of Human Impacts

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## ABSTRACT

*This paper relates land use in three villages of Vietnam's northern mountains to a variety of potential socio-economic influences on the villages' land use practices. The villages are inhabited by different ethnic groups, including ethnic minority groups and the ethnic Vietnamese majority, which differ in their degree of community cohesion. Land use pattern in the villages are compared by remote image analysis, drawing on satellite images from the 1950s to 2000. The analysis uses a variety of measures, primarily vegetation cover, vegetation cover patch size, and the number of patches. Socio-economic factors with potential influence on land use originate from a survey conducted in the villages. They cover various socio-economic aspects, primarily infrastructure access, population, poverty, policy implementation, and community cohesion. A large part of the literature on resource use suggests that communities manage natural resources well. By presenting different patterns of land use in the three villages, this paper subjects this claim to an empirical test.*

## 1. INTRODUCTION

In Vietnam hills and mountains occupy 3 quarters area of the country. In mind of lowlander forest is abundant and can be seen everywhere in the region. However, this home of 1/3 nation population has undergone rapid changes following socio-economic developments. Forest and land, the main sources of local production system, has been impacted severely over the last decades. Forest cover has reduced from 43.2% in 1943 to 28.1% in 1995 (Nguyen Manh Cuong, 1999). However, processes of changes are not well understood. Understanding the changes in the forest cover and land use is important for improving management.

Deforestation has been identified as major causes of environmental degradation, soil erosion, low agricultural productivity and reservoir sedimentation. While population expansion is usually considered as main cause of deforestation in a long period, other driving forces of deforestation such as policies, economic development and introduction of new technologies were not easy to identify and single out. On the other hand, lacks of forest data at such times also prohibited researchers to reach any concrete conclusions.

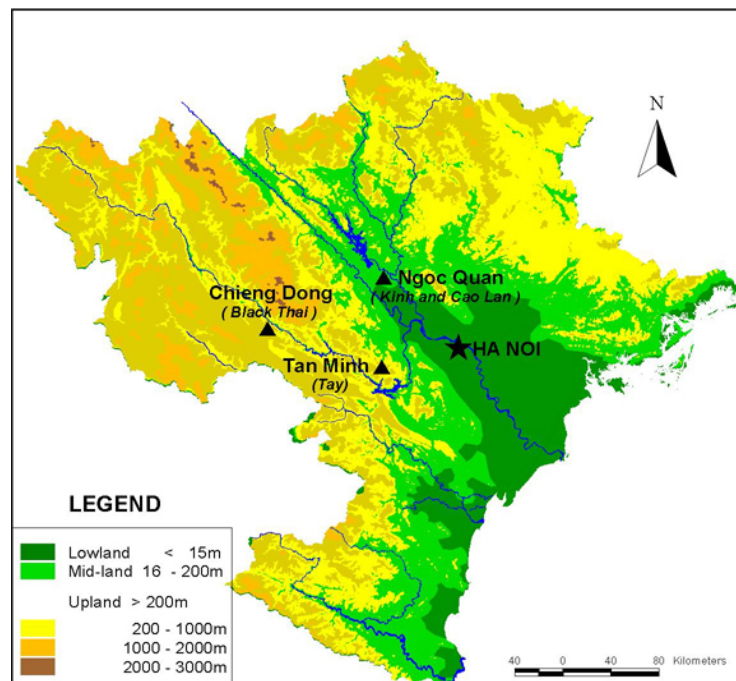
Remote sensing has been proved as sources of detail, reliable and frequent data for used in the management, monitoring and mapping of natural resources. Studies of land cover-land

use changes using remotely sensing data can take advantage of having consistent and comparable data.

This study used several remote sensing data types including aerial photos, high resolution satellite images of Corona, SPOT and Landsat TM for mapping and analyzing of land cover-land use changes at three study sites. Dynamics of land cover-land use based on the analysis of remote sensing generated maps/data is not only providing specific picture of each study site but also a “panorama view” of the Northern Mountain Region (NMR). Analyzing land cover-land use in the context of historical events has revealed its relationships with potential influence factors, such as population, poverty, policy and technology.

## 2. THE STUDY SITES

The study sites are located in different parts of Vietnam’s Northern Mountain Region (Figure 1). Ngoc Quan is in the central North region, Tan Minh and Chieng Dong in the lower and upper part of Vietnam’s Northwestern mountains.



**Figure 1. Location of the study sites in Vietnam’s NMR**

Ngoc Quan village is one of 27 villages and town of Doan Hung district, Phu Tho Province. The village is located in the rolling hills of the midlands. In year 2000, the village is inhabited by Kinh and Cao Lan ethnic group. 93% of village’s households engage in agricultural activities including wet rice growing, dry land-cash crop agriculture, animal husbandry and planting industrial trees.

Tan Minh village of Da Bac district, Hoa Binh province is located in the mountain valley on the left of Hoa Binh reservoir on the Da river. The village has a lineal settlement pattern with houses built along the sides of the road, on the lower slopes of long and narrow

valleys. In 1995, it has 9 hamlets with a total population of 2820 living in 497 households. The Tay is the major group, living in 8 hamlets while the Dzaio population lives in only 1 hamlet. Local livelihood is mainly dependent on agricultural production. Agricultural production is a mixture of irrigated rice cultivation and swiddening (shifting cultivation) on the surrounding mountain slopes, and animal husbandry.

Chieng Dong village is classified as mountainous village of Yen Chau district, Son La province. There are several ethnic groups living in Chieng Dong, among which the Black Thai is a major group accounting for 96% of the village's population. Other groups include H'mong, Kinh and the Kho Mu. The village has settlements on the valley of Hit and Vat stream, a tributary of the Da river. Crop cultivation and animal husbandry are the major activities. Villagers have wet rice fields in the valleys and swidden fields on the slope surrounding their houses and on the back of the village.

### 3. MATERIALS AND METHOD

The study has followed a two-prolonged approach, combining the interpretation of remote imagery with socioeconomic field research. The remote sensing data used in this study is summarized in table 1.

**Table 1. Land cover-land use data sources**

Study sites		Type of data			
<b>Ngoc Quan</b> (Doan Hung dist.)	Aerial photo 1952	Corona 1967	Aerial photo 1973	Landsat TM 1989	Landsat TM 2000
<b>Chieng Dong</b> (Yen Chau dist.)	Aerial photo 1952	Corona 1968	Corona 1979	SPOT 1989	SPOT 1997
<b>Tan Minh</b> (Da Bac dist.)	Aerial photo 1952	Corona 1966	Corona 1975	Landsat TM 1989	Landsat TM 1998

The land cover data was generated from aerial photo and satellite image interpretation. Interpretation of aerial photos and satellite images at different times of each study site will allow a specific description of land cover and land use change in different parts of NMR. Comparative analysis of land cover and land use changes of these study sites will give a picture of how vegetation change in NMR.

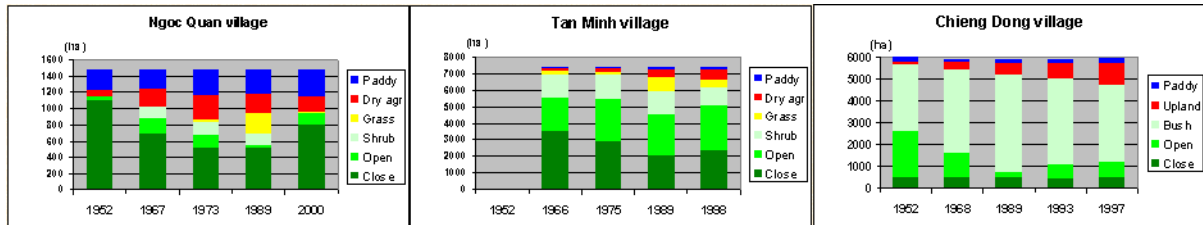
Field research includes interviews with local officers and statistical data collections. Interviews with local people and officers at the hamlet and district levels with focus on agricultural practices, forest uses, living conditions has helped to understand and to identify major factors related to land cover and land use changes.

### 4. RESULTS

Results of remote sensing interpretations (figure 2) show that in the 1950s the study sites were covered by forest vegetation. In general, forest cover (close and open canopy) has decreased at all study sites over the last 50 years. However, forest cover did not decreased throughout the period, it went down to the lowest level in 1989 (time of images available) and then reverted after that. Among the 3 sites, Chieng Dong and Ngoc Quan had higher rate

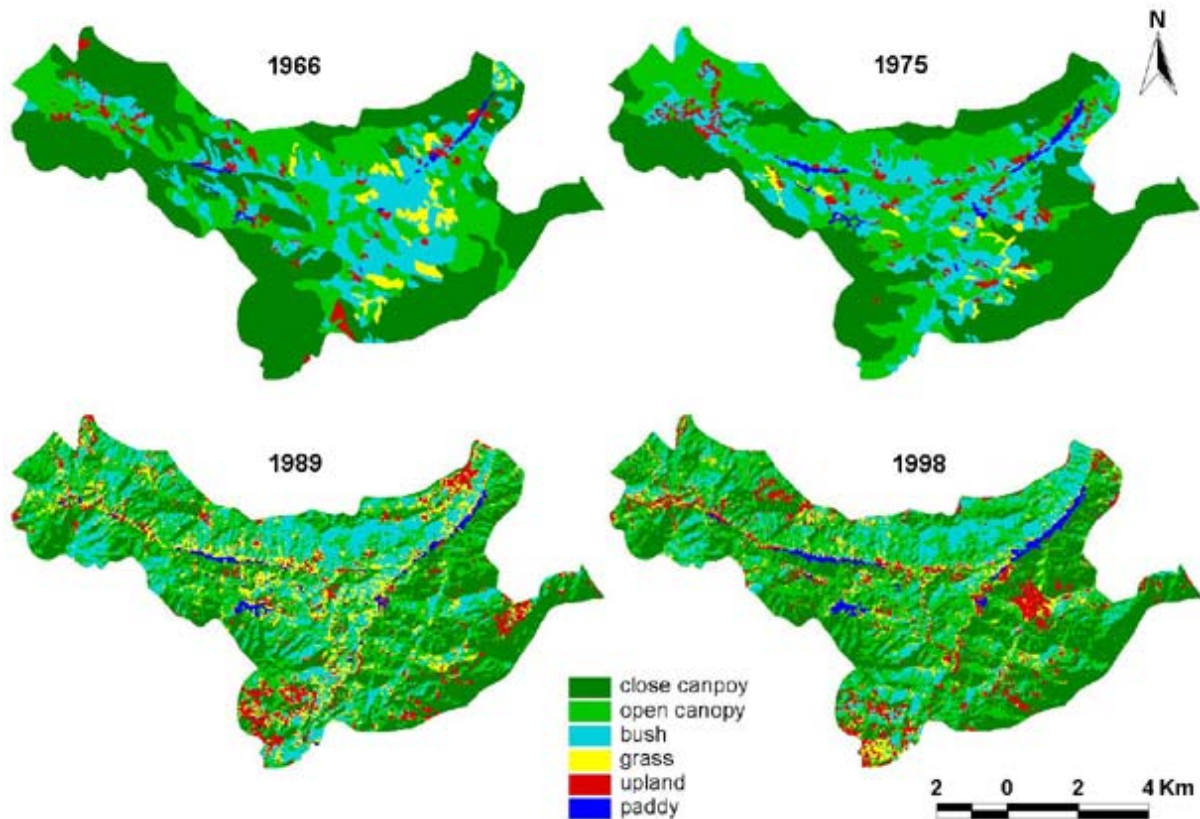
of deforestation. Today, forest cover in Chieng Dong is only about 50% of what it was in the 1950s. At any time point, Ngoc Quan and especially Tan Minh always had higher percentage of forest cover than in Chieng Dong. Chieng Dong had highest percentage of fallow land in the form of bush and grass. Ngoc Quan had low percentage of “fallow” land because they practiced “permanent” dry land cash crop agriculture instead of swiddening.

**Figure 2. Land cover-land use of the study sites**



On the agricultural land use aspect, except Ngoc Quan, paddy area in Chieng Dong and Tan Minh occupies very small share in comparison to dry land agriculture. While paddy area has remained almost unchanged over time, upland area has increased continuously, except for Ngoc Quan because there is difficulty in separation between land under preparation for cash crop agriculture and for industrial purposes (tea and tree plantation).

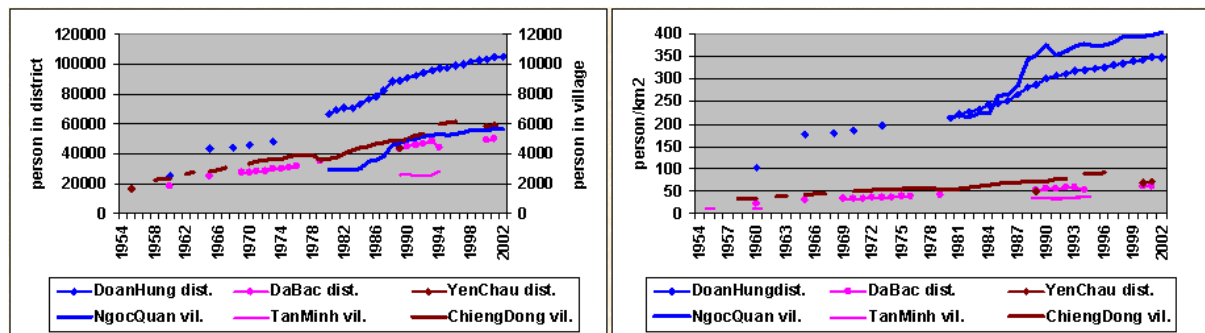
Visual comparisons of land cover-land use maps (figure 3) has shown that there were more and more land cover fragmentation. Statistically, it shows the increasing number of land cover-land use patches.



**Figure 3. Land cover-land use of Tan Minh Village**

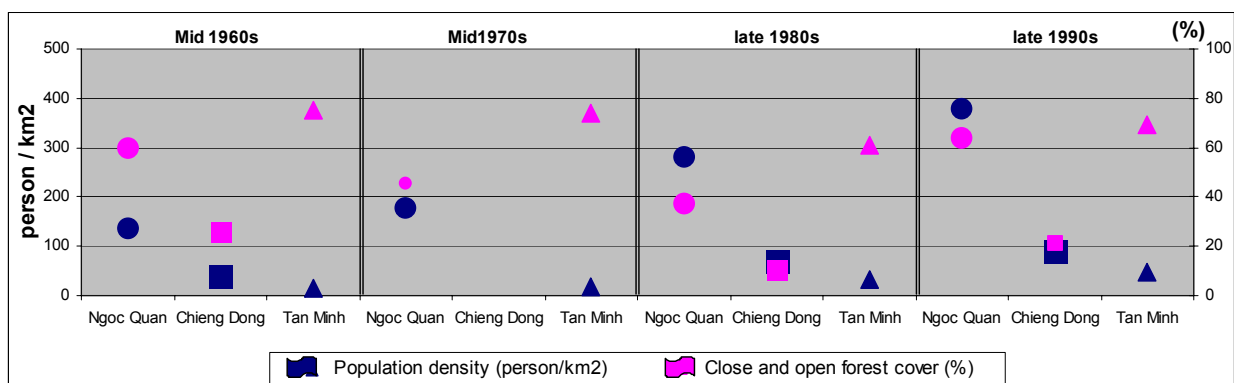
Clearly, human has impacts on their environment as many literatures discussing the role of fragmentation: the size of natural land-cover can serve as an indicator of the environmental health of the area from a conservation standpoint; or the number of patch and patch size can serve as an indicator of how extensive human has influence on the landscape.

As everyone recognized that population growth has led to an increasing food demand and subsequently to an increase in agriculture area. Our analysis also shows a positive correlation between population (figure 2 and 4) with agricultural land area in the 3 villages. The analysis also shows an inverse correlation with forest cover in the 3 villages until 1989 as finding of many studies (Brown ed., 1994, Fox. et al., 1995, Sikor et al., 2004). However, after 1989, forest cover has increased when population increased. This is a quite opposite with the view mention above. Many factors can be attributed to this correlation such as forest law, land law, law enforcement and agricultural technologies.



**Figure 4. Population and population density**

Recent study (Leisz et al., 2001) has suggested that the higher the population density of an area has been, the more degraded the natural resource of that area would be. Our analysis shows that there is an inverse correlation between population density and natural forest cover (figure 5). The results show that the lowest population of Tan Minh always had the highest forest cover (figure 5). Ngoc Quan again is an exception case. Because they could have intensified paddy agriculture which farm size was larger than other sites and have planted trees for commercial purpose.



**Figure 5. Relationship between population density and forest cover**

## 5. CONCLUSION

Land cover-land use can be quantified from remote sensing imagery. Rates and trend of land cover-land use change during 5 decades can be identified. The study shows the variations in LCLU and its changes in the NMR. It indicates influences of physio-ecology aspects as well as socio-economy conditions between these sites.

Results of remote sensing image analysis can provide baseline information that can be used with other information such as population, policies and technology to evaluate and forecast its influence on land cover-land use. Therefore, it can propose a better resources management strategy in response to new policies and economy

## REFERENCES

- Brown, K. & Pearce, D.W., eds. 1994. *The Causes of Tropical Deforestation: The economic and statistical analysis of factors giving rise to the loss of the tropical forests*. London: UCL Press.
- Fox J, Krummel J, Yarnasarn S, Ekasingh M, Podger N. 1995. *Land Use and Landscape Dynamics on Northern Thailand: Assessing Change in Three Upland Watersheds*. *Ambio* 24:328-334.
- Leisz, Stephen J., Dao Minh Truong, and Le Tran Chan, Le Trong Hai. 2001. Land-cover and land-use. In Le Trong Cuc and A. Terry Rambo, eds., *Bright Peaks, Dark Valleys: A comparative analysis of environmental and social conditions and development trends in five communities in Vietnam's northern mountain region*. pp. 85-122. Hanoi: National Political Publishing House.
- Lillesand, Thomas M. and Ralph Kiefer 1994. *Remote sensing and image interpretation*. John Wiley and Sons, Inc. New York
- Nguyen Manh Cuong, 1999. *Information Technologies for Forest Management in Vietnam. Workshop Proceedings: Application of Resource Information Technologies GIS/GPS/RS) in Forest Land & Resources Management. October 18 - 20, 1999. Hanoi, Vietnam*
- Sikor, Thomas and Dao Minh Truong. 2004. Change in Land Use in Black Thai villages in Response to Changes in the National Land Management Policies. In Furukawa Hisao, et al., eds, *Ecological Destruction Health, and Development*, Kyoto University Press.