

Context

Forest transition theory

The forest transition theory was developed to understand the shift from deforestation to reforestation, and then the regrowth of a stable and extended forest cover, that occurred in several countries (Mather and Needle, 1998). Several economical, technological, institutional and cultural factors explain this transition, combined in different pathways (Rudel et al., 2005). The economic development path suggests that, because of economic expansion, labour force is driven from agriculture to other economic sectors and from rural to urban areas. At the same time, due to market development, agricultural intensification is concentrated in the most suitable regions. Large areas of land marginally suitable for agriculture are therefore abandoned and left to forest regeneration. In the forest scarcity path, political and economic changes will arise as a response to the growing scarcity of forest products and decrease in the provision of ecosystem services following.

Deforestation and reforestation in Vietnam

In Vietnam, since the early 1990s, after an intense deforestation period, a net reforestation has been observed in the mountains that cover two-thirds of the country (Fig. 1) (De Koninck 1999, Jamieson et al. 1998, Castella and Quang 2002). Policy and economic changes, as well a vigorous reforestation programs have been suggested to be the causes of this reforestation. However, other studies cast doubts on the effectiveness of the government measures to reforest the country, and on the trends in forest cover (Lang 2001, McElwee 2004).



Fig. 1. Reforestation landscape in the northwest of Vietnam. In front, longan (*dimocarpus longan*). Behind, plantation of teak (*tectona grandis*) exploited for wood. In the background, a secondary forest with a mix of trees and bamboos. Picture: P. Meyfroidt, 2008.

The conditions of a successful transition and the role of information and perceptions

In a broader context, some studies are summarizing the general factors that promote a successful transition towards sustainable management of natural resources (Lambin 2005). Three broad groups of factors that have been identified: information regarding the state of the resources and their degradation, motivations to search for solutions, and capacity to implement effective solutions. The first one, information, has been the least studied in land use studies (Raquez and Lambin 2007). Studies about Traditional Ecological Knowledge (TEK) also emphasize the role of local information and perceptions in natural resource management (Berkes et al. 2000). Mental maps contribute to this knowledge (McKenna et al. 2008). Environmental degradation of places with which people maintain an emotional connection can lead these people to adopt a

more ecological worldview and to reassess their involvement in conservation activities (Marshall et al. 2005, Rogan et al. 2005). The perception of the capacity to predict and improve the state of the environment also mediates behaviour (Ostrom 1999, Agrawal 2001, Ajzen 2002).

Objectives

The general aim of this thesis is to test and improve the current knowledge on forest and land transitions, by studying the case of Vietnam. Several objectives are therefore pursued: firstly, the actual status and trend of forest cover in Vietnam have to be assessed, to clarify if a forest transition actually took place in Vietnam during the 1990s, and describe its characteristics. Secondly, to study the causes of the forest cover changes and the relative importance of different factors, in relation to the current forest transition theory. The specific role of leakage of the deforestation to other countries has to be assessed. Thirdly, to examine the impacts of this transition on its key environmental attributes relevant for global environmental change, biomass carbon stocks and forest fragmentation, habitat quality and biodiversity. Fourthly, using case studies at local level, to study the role of information and perceptions of forest scarcity and environmental degradation in the forest transition of Vietnam.

Data and Methods

At national scale:

The available forest cover maps of Vietnam for the early and late 1990s, made by official agencies of the Vietnam government or by various international research projects are compiled and compared. After homogenizing the spatial and thematic content, Fuzzy Kappa and other indicators of spatial pattern are used to select the most valid maps, and assess the forest cover in Vietnam at these dates. The long term trends of forest cover are then reconstructed by compiling these data with other evaluated sources: forest cover statistics from official surveys, various maps and other published data.

The causes of the reforestation during the 1990s are analyzed using multivariate spatial lag regression at district level, supported by a review of local case studies. The forest cover data are the forest cover maps made by the Forest Inventory and Planning Institute (FIPI), which proved to be valid during the previous step. The socio-economic data come mainly from the two exhaustive rural, agricultural and forestry censuses realized in 1994 and 2001, and other statistical sources.

Leakages are assessed by compiling statistics of wood demand (for industries, international trade and other uses), wood production and imports, including illegal sources and destinations, and converting these numbers to forest area.

Changes in biomass carbon stock from 1980 to 2005 are assessed by using FAO and FIPI data and biomass density parameters based on the literature and on the biome map by Olson et al. (2001). The changes in forest fragmentation between 1992-1993 and 2000-2001 are assessed using the Vegetation Continuous Fields maps by University of Maryland (DeFries et al. 2000, Hansen et al. 2003).

At local scale:

Four villages are studied. In each village, land cover trends since the 1970s are assessed with remote sensing data. The land use changes are analyzed by combining socio-economic and agricultural statistics from official sources (village, commune and district) and from interviews with farmers based on closed-ended questions. The environmental information and perceptions of the farmers and local officials are studied by combining several methods: structured and semi-structured individual interviews with mainly open-ended questions, group discussions, individual mental maps and participatory group maps using a 1/10.000 scale printed Spot 5 image as a basis. Official land cover and land use planning maps are also collected.

The comparison between forest cover trends and pattern derived from independent remote sensing sources, from the official forest maps and from the village maps made by local land managers allow to analyze the contrasted views of the forests.

Preliminary results

The analysis of available forest cover data demonstrates unambiguously that a forest transition occurred in Vietnam, with the turning point around 1991-1993 at around 25-31% of land covered by forest (Fig. 2) (Meyfroidt and Lambin, 2008a). The forest cover then increased to around 32-37% in 1999-2001. The reforestation was due, in similar proportions, to natural forest regeneration and plantations. The rate of reforestation was higher than the rate of deforestation during the previous decades. Forest regrowth in Vietnam was not due to a single process or policy but to a combination of economic and political responses to forest and land scarcity, economic growth, and market integration at the scale of the country (Meyfroidt and Lambin 2008b). The distribution of forestry land to households, new forest management practices, and food crop intensification were combined in "push and pull" effects to decrease the footprint of agriculture on hillsides. Land scarcity provided strong incentives for agricultural intensification and the sound management of forests. These processes partly correspond to the two pathways described in the emerging forest transition theory – the economic development path and the forest scarcity path –, and also to a smallholder agricultural intensification pathway linked to the theory of agricultural intensification of Boserup.

Despite a decreasing density of biomass due to the degradation of forests and the increasing proportion of young trees, the total carbon stock in forests also followed a pattern of transition (Meyfroidt and Lambin, 2008a). Forests in Vietnam represented a net carbon sink of around 36 TgC per year since the beginning of the 1990s. Forests in some regions became more fragmented and subjected to edge effects, while the opposite occurred in other regions (Meyfroidt and Lambin, 2008a). The effects of the forest transition on biodiversity are thus likely to vary between ecoregions and biodiversity is most likely still threatened in Vietnam.

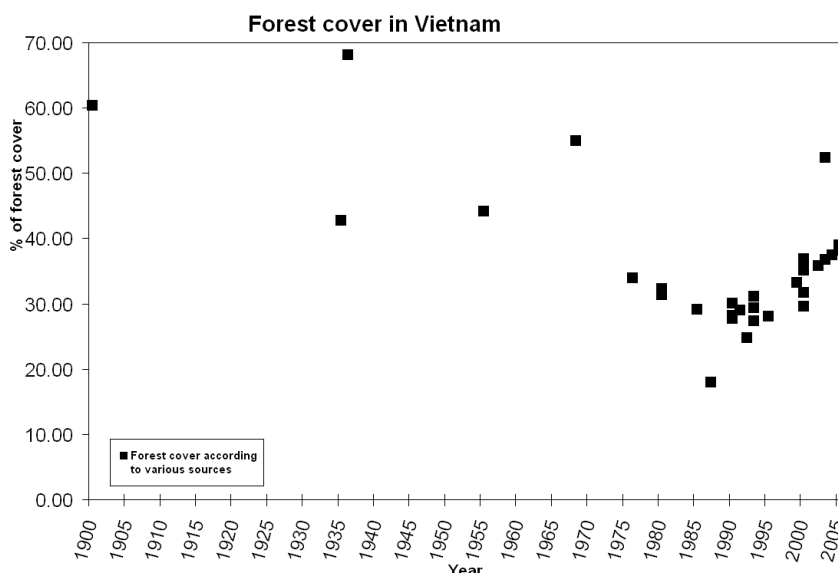


Fig. 2. Forest cover in Vietnam at several dates according to different sources. Adapted from Meyfroidt and Lambin (2008a).

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