

Lost in transition: Forest transition and natural forest loss in tropical China



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ABSTRACT

The term forest transition refers to a change in forest cover over a given area from a period of net forest area loss to a period of net gain. Whether transitioning from deforestation to reforestation can lead to improved ecosystem services, depends on the quality and characteristics of the newly established forest cover. Using publicly available data, we examine forest transition in two regions of tropical China: Hainan Island and Xishuangbanna. We found that the overall increase of forest cover in both areas during the 1980s was due to an increase in plantation forests rather than to increases in the area covered by natural forest. We also found a time lag between the increase in overall forest cover and an increase in natural forest. On Hainan Island, natural forest continued to decline beyond the point in time when overall forest cover had started to increase, and only began to recover ten years after the turning point in 1978. In Xishuangbanna, where the transition point occurred ten years later, the decline of natural forest cover is still going on. These divergent trends underlying forest transition are concealed by the continued practice to apply the term “forest” broadly, without distinguishing between natural forests and planted forests. Due to the use of indiscriminating terminology, the loss of natural forest may go unnoticed, increasing the risk of plantation forests displacing natural forests in the course of forest transition. Our findings are important for programs related to forest management and ecosystem services improvement, including reforestation and Payments for Ecosystem Services programs.

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1. Introduction

Forest Transition theory has been used to explain the change from shrinking to expanding forest cover (Mather, 1992; Mather and Needle, 1998). Forest transition refers to the turning point from net forest area loss to net forest area gain. Forest transitions have been identified in countries of Europe and North America (Mather, 1992; Mather et al., 1998, 1999; Mather, 2004; Kauppi et al., 2006), and recently also in many developing countries (Mather, 2007; Rudel et al., 2005; Meyfroidt and Lambin, 2008, 2010).

Forest transition towards more forest cover is assumed to have the potential to improve environmental services (Mather, 2007;

Rudel et al., 2005). In order to realize this potential, forest researchers have attempted to identify the causes of forest transition, as well as variables which may promote or speed up the process of transition (Xu et al., 2007; Culas, 2012; Mather, 2007; Rudel et al., 2005).

China passed through the turning point of its forest transition during the 1980s, when state policies played a central role (Mather, 2007; Rudel, 2009; Rudel et al., 2005). In our previous research, we found a paradox between a continuing decline in the area covered by natural forests and an increase in overall forest cover in tropical China (Xu, 2011; Ziegler et al., 2009; Zhai et al., 2014).

Rubber trees were introduced to tropical China more than fifty years ago, and were initially managed by state farms, the majority of which were established during the 1950s (Xu et al., 2014; Lardy, 1983). From the late 1980s onwards, the expansion of rubber plantations accelerated due to the involvement of local smallholders (Zhai et al., 2012; Xu et al., 2014). The area occupied by rubber plantations in Hainan has increased by 21.71% since the

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1950s: from 0.54% of total land area in the 1950s to 14.16% in 1988, and to 22.25% in 2008 (Wang et al., 2012). In Xishuangbanna, the area occupied by rubber plantations has increased since the 1970s by 20.89%: from 1.25% of total land area in 1976 to 3.63% in 1988, to 11.30% in 2003, and to 22.14% in 2010 (Xu et al., 2014; Li et al., 2007).

During the same period, natural forest cover has decreased in both regions. In Xishuangbanna, the area covered by natural forest has decreased by more than 30% over the last forty years (Li et al., 2007; Jing and Ma, 2012). In Hainan, natural forest cover has decreased from 24.45% of total land area in the 1950s to 13.50% in 1980, and again to 8.30% in 1988. By 1995 however, the area covered by natural forest had increased to 12.00% (Zhang et al., 2000).

In our previous research in Xishuangbanna, we found that natural forest loss was mainly caused by the expansion of plantation forests (Zhai et al., 2015). We also found that in Xishuangbanna deforestation coexisted with plantation expansion in the overall process of forest transition. Based on our previous research findings and on our observations in the field, we hypothesized that it was mainly the expansion of plantation forests that has contributed to the increase of overall forest cover. We selected Hainan Island and Xishuangbanna prefecture as our study sites in order to investigate this hypothesis, and used data on rubber plantations to investigate the role of plantation forests. The current stage of forest transition in tropical China, with its interplay of forest cover increase, natural forest loss, and forest plantation expansion provides us with a unique opportunity to study current forest transition theory at a fine scale, and to demonstrate the importance of differentiating between forest types in forest transition.

In this research, we investigated the dynamics of changes in overall forest cover, natural forest cover, and rubber plantation cover in tropical China in order to answer the following questions:

- 1) When did the turning point of forest transition occur in tropical China? 2) What is the relationship between changes in natural forests and plantation forests in forest transition? and 3) What are the implications of this relationship for Reducing Emissions from Deforestation and Degradation and Enhancing Forest Carbon Stocks (REDD+) projects?

2. Methods

2.1. Study sites

Hainan Island and Xishuangbanna are the two largest tropical regions in China and are both considered biodiversity hotspots (Francisco-Ortega et al., 2010; Zhu and Roos, 2004) (Fig. 1).

Hainan Island (18°10'–20°10' N and 108°37'–111°03' E) is the largest tropical island in China with an area of 33,920 km². The island's tropical rainforests are located at the northern margin of tropical Asia (Zhu and Roos, 2004) and are known for their high biodiversity. The northern part of Hainan Island is relatively flat with an overall elevation of 300 m above sea level. The southern part is hilly, with Wuzhishan in the center of the island being the highest mountain (1876 m) (Francisco-Ortega et al., 2010). Approximately 39% of Hainan Island is covered by mountains and hills. The island has a tropical monsoonal climate, with a rainy season from May to October and a dry season from November to April (Zhai et al., 2012). Its average annual rainfall is more than 1600 mm. The main forest types are tropical savannas, tropical monsoon forests with evergreen and deciduous trees, lowland or montane seasonal evergreen rainforests, and mangrove and tropical bamboo forests (Francisco-Ortega et al., 2010).

Xishuangbanna Prefecture (21°08'–22°36' N, 99°56'–101°50' E) in Yunnan Province covers 19,150 km² and borders Laos to the south and Myanmar to the southwest. Its altitude varies from

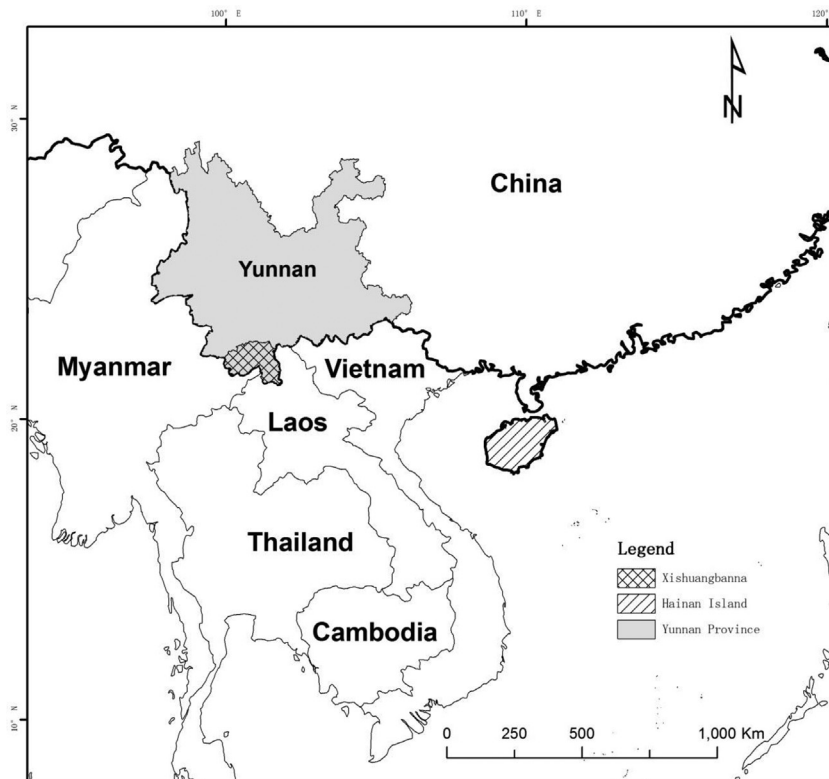


Fig. 1. Location of Xishuangbanna Prefecture and Hainan Island.

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