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## Forest transition and socio-economic development in India and their implications for forest transition theory<sup>☆</sup>

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### ABSTRACT

The paper provides a detailed analysis of forest transition in India, exploring the direct and underlying causes and factors that explain deforestation and forest degradation, decline in deforestation and forest degradation, and forest recovery. The paper reviews these causes and factors during the periods before India experienced forest transition and after it experienced forest transition, which happened during the 1980s. Causes and forces that caused deforestation and forest degradation were forest exploitation for timber, an increased population that sought agricultural land, economic modernization through expansion of agricultural production, forest dependence and related forest exploitation, and even forest conversion when forest land became notified and thus forest owners lost rights to derive benefits from forests. Causes and factors that reduced deforestation and forest degradation and resulted in forest recovery, included agricultural intensification, government policies, private tree and forest production and smallholder and community forestry. Multiple forest transition pathways can be signaled as having contributed to forest transition pathways in India. The case of India actually question to what extent the forest transition pathway concept is valid for contemporary forest transition in complex countries like India.

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### 1. Introduction

Forest transition (FT) is a process in which in a given territory and over a period of time the area of forest cover declines until it reaches a lowest point, after which the forest area gradually recovers. The process was first described for Europe, later for North America and eventually also for countries outside those two regions (Mather, 1992; Mather and Needle, 1998; Rudel et al., 2005; Walker, 1993). FT has been linked to economic development, industrialization and urbanization. These processes reduce the conversion of forest lands and free up land that returns to forest (Rudel et al., 2005). FT is also influenced by government forest policies, processes of globalization and tree based land use intensification (Lambin and Meyfroidt, 2010). FT has to date mostly been analyzed at a national scale, but more recently it is also analyzed at sub-national scales (Meyfroidt, 2013) and at multinational scales e.g. (Rudel et al., 2005; Mather, 2007).

Asia is one region where forest transition has taken place as in several countries the net loss of forests that persisted for many decades has now been halted and is replaced by a net increase in forest cover (Mather, 2007; Meyfroidt and Lambin, 2011; Southworth et al., 2010). India's

forest area began to increase since about the 1980s, when the country had a forest cover of 19% (Singh et al., 2014). The country experienced a sustained forest cover decline in the order of 14 million ha during 1901–1950 and 18.5 million ha during the 1950–1980 period (Singh, 2011). These estimates do not include the area under shifting cultivation, which is approximately 7 million ha (Table 1; Singh, 2011). Southworth et al. (2010) confirm a progressive forest cover increase since then, by comparing data for the years 1990, 2000 and 2005 reported in FAO (2006).

While forest transition is occurring increasingly more often (Meyfroidt and Lambin, 2011) the process can better be analyzed and thus becomes better understood (see also other papers in this volume). This is a result of more cases that can be studied, but also of better data becoming available, because of improved research methods. Chief among those is improved imagery technology that allows for more accurate monitoring of land use and land cover change. In addition, improved keeping of related socio-economic data, including information related to public policies also improves the material available to explore underlying causes of forest transition in many locations.

Since researchers became aware of forest transition, much attention has been given to what are the underlying causes of the process. This has resulted in a number of theoretical propositions. For instance, forest transition is explained as following so called forest transition pathways (Mather and Needle, 1998; Rudel et al., 2005). In the pathway

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**Table 1**  
Forest cover trend for India since 1900 (M ha).  
Source: Singh et al. (2014).

Year	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010
Forest cover	89.9	87.1	87	83.3	79.4	75.8	69.1	62.9	63.4	66.23	66.88	69.2

framework, a particular pathway represents a dominant cause that can be considered responsible for forest transition. Lambin and Meyfroidt (2010), for instance, propose five forest transition pathways identified as: the economic development, forest scarcity, government policy, globalization, and smallholder tree based land use intensification pathways. In the economic development pathway, processes related to economic development are mostly responsible for forest transition. Economic growth increases production costs which pull labor away from marginal agriculture to industrial production. This causes marginal agricultural land to be abandoned, which then is returned to forests. Under the economic development pathway, improved production costs, but also higher consumption levels lead to intensification of agricultural production with improved production technologies that are more costly, but also result in higher per hectare yields. This equally resulted in land abandonment and reforestation.

In addition to forest transition pathways, a conceptual mathematical approach to describe forest transition is the proposition that forest transition follows an inverse environmental Kuznets curve. The Kuznets curve explanation of forest transition represents an analytical model of the economic development forest transition pathway. It essential argues that forest cover in a particular region follows an inverse u-curve and that the independent variable is an economic indicator, mostly per-capita GDP. The precise u-curve relation between forest cover and per capita income is much debated (e.g. Chowdhury and Moran, 2012).

In addition, the pathway explanation model, however, does have its challenges (i.e. Perz and Skole, 2003). The question that needs to be asked is how well do the proposed forest transition pathways actually fit with the processes that cause forest transition. A second related question is, how do the forces that result in forest transition evolve along the process of forest transition. The last question relates to the first one, as it essentially asks for understanding more of the details of the complex processes that are captured by forest transition attributed to a particular pathway or a combination of pathways.

The immediate objective of this paper is to contribute evidence for the understanding of forest transition in India and its direct and underlying causes. We use this analysis to also assess how well the forest transition pathway framework reflects the reality in forest transition in countries like India, where forest transition has been more recent. This also can be formulated as, how do cases like India compare to historical cases of forest transition, mostly located in Europe, where more straightforward explanations, like the economic development pathway, or forest scarcity pathway (Rudel et al., 2005) do appear to adequately reflect forest transition.

India has experienced forest transition since the 1980s. It is possible to disaggregate Indian forest transition as resulting from multiple direct causes and indirect or underlying causes that include deforestation, forest degradation, but also forest conservation, sustainable management of forests, afforestation and forest rehabilitation (Fig. 1). These

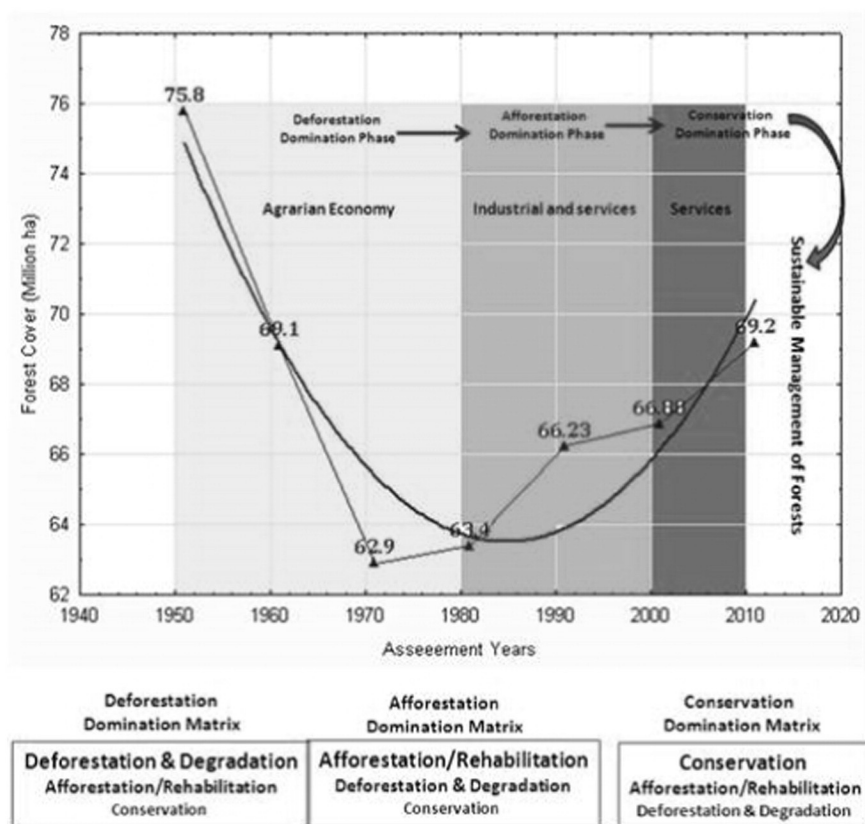


Fig. 1. Forest transition phases of India in different stages of development.

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