

Partnership for the Tropical Forest Marains

Policybriefs

Drivers and consequences of tropical forest transitions: options to bypass land degradation?

The early studies of the ASB Partnership for the Tropical Forest Margins stratified the domain for study into stages of a generic transition pathway that suggested a strongly non-linear trajectory of change. In this scheme, a phase of degradation of aboveground vegetation, based on over-logging or shortening fallow cycles in intensified swiddens can lead to a grass-fire cycle that needs special conditions to allow successful rehabilitation. Many places with current agroforestry and tree mosaics have gone through such a phase. A new review of the global literature on these 'forest transitions' by Meyfroidt and Lambin (2011) framed important conclusions.

Main findings

1) Recovery of tree cover has occurred with many variations of patterns and processes; the forest transition is not a deterministic pathway but an abstraction of reality that is contingent and only occurs under certain conditions.

2) The two broad forces of forest transitions are pull and push. Pull factors induce land abandonment and natural regrowth due to agricultural changes and attraction of the labour force to urban and off-farm jobs. Push factors increase the value of land with high tree cover in response to market signals of increased demand for tree products and forest services leading to agroforestry and plantation forestry and/or by policies that promote tree planting and restrict extraction from natural forests. Policies restricting land uses in forest zones have contributed to forest protection and recovery but often at a high *Continues on Page 2*



consequences for the linkages across the landscape (Source: van Noordwijk et al., 1995, 2001; modified by various subsequent authors)

Implications

- Linear extrapolation into the future of past rates of 'degradation' has no solid empirical basis, but the onset of a possible forest recovery in a country is not automatic and can nowhere be taken for granted.
- Push and pull factors often interact, but transformations of national economies to urban and service sector jobs required for the pull scenario is likely to be slow in many developing countries; Agricultural intensification as a pull factor can allow to spare land for forests only if accompanied by land zoning and similar policies. Superior value of treebased land uses is the scenario that is the most likely to bring benefits to forest dwellers and smallholders.
- Increase of forest area is not a guarantee for a recovery of ecosystem services: the hydrological impacts of fast-growing trees can be mixed,

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cost to local populations.

3) The ecological effects of recovery of tree cover ('reforestation') differ with the type of vegetation, the previous land use/cover, and the relations between recovery at one place and ongoing deforestation elsewhere.

4) Land use trajectories that avoid a low tree-cover phase and 'bypass' the high emission stages are often targeted in REDD+ policies; examples exist in transitions of swiddens to agroforests rather than intensive annual cropping systems degrading into grasslands with frequent fire. Changes in land tenure regime are often key to change in tree cover.

1. Recovery of tree cover has occurred with many variations of pattern and processes; the forest transition is not a deterministic pathway but an abstraction of a reality that is contingent and only occurs under certain conditions.

Linear extrapolation into the future of past rates of 'degradation', as is commonly portrayed in REDD+ baseline discussions, has no solid empirical basis. However, there is no evidence that all countries will necessarily experience a long-term turnaround in forest or tree cover trend with economic development. Furthermore, when they occur, forest transitions result from different pathways that depend on the local socioeconomic and ecological contexts. Multiple causes, social and environmental contexts, and path dependencies are associated with these forest cover changes. The factors driving deforestation also control reforestation, depending on particular circumstances and small contextual shifts, e.g., urbanization, economic development, rural wages, agricultural prices, population density, demand for wood products, land tenure reforms, and trade. Thus, because countries do not necessarily follow a regular pattern of forest cover changes, and the causes and outcomes

biodiversity recovery slow, and carbon stock increments small. Large scale monocultures of exotic tree species can reduce the provision of ecosystem services.

 As there is no default forest transition pathway, opportunities for 'bypass' trajectories are feasible, but require context-specific analysis of the constraints to emergence of high-value-high-Cstock land uses; shifts from state-controlled forest to other tenure regimes is often needed to achieve such scenarios.

of forest transitions vary, forest transition is to be seen as a contingent process, and as an empirical regularity rather than one stage in a predictable, universal and deterministic path of land use patterns. Forest transition graphs can play a positive role in public policy discourse as they point to opportunities for a reversal of 'deforestation' trends by appropriate policy actions. Such actions will, however, require understanding of the driving forces in local context, rather than relying on generic forest transition dynamics as a 'law of Nature'.

The onset of a possible forest recovery in a country is not automatic and can nowhere be taken for granted. In other words, the position of a country along the so-called "forest transition curve" at one point in time is not predictive of its future trajectory and cannot be used for example to estimate a baseline for expected deforestation in the future under a business-as-usual scenario.

2. Two broad forces of forest transitions are pull and push: Pull factors induce land abandonment and natural regrowth, e.g. through agricultural



Meyfroidt P, Lambin EF. 2011.

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changes and attraction of the labour force to urban and off-farm jobs; Push factors increase the value of land with high tree cover.

Push factors can be expected in response to market signals of increased demand for tree products and forest services leading to agroforestry and plantation forestry and/or by policies that promote tree planting and restrict extraction from natural forests. Policies to prevent change and arrest land in the early part of a forest transition trajectory, by restricting land uses in forest zones have contributed to forest protection and recovery but often at a high cost to local populations.

Beyond the many contextual variations, a few generic pathways of forest transition can be identified, that combine differently in each singular case. Forest transitions often involve a combination of socioecological feedbacks from forest decline and of broader socioeconomic changes. Geographically, in Central America and the Caribbean, reforestation occurs more commonly on abandoned land, usually associated with economic changes and globalization. Forest plantations are more common in subtropical and temperate South America, often driven by private actors, and in Asia, through a combination of decentralization and market-driven plantations or larger state-sponsored programs. Afforestation policies may result in large-scale plantations but also in scattered woodlots on smallholders' plots. Land-use policies restricting activities on forestlands and agricultural changes also contributed to forest regrowth in Asia. In sub-Saharan Africa, forest plantations and agroforestry expand locally in countries with high population densities and supportive forest policies.

Push and pull factors of forest transitions often interact, but transformations of national economies to urban and service sector jobs that is required for the pull scenario is likely to occur slowly in many developing countries. Agricultural intensification can allow sparing land for forests only if accompanied by land zoning and other policies to control for a rebound effect (Lambin and Meyfroidt, 2011). Superior value of tree-based land uses is the scenario that is most likely to bring benefits to forest dwellers and smallholders. Forest recovery might not always have beneficial effects for the livelihood of forest-dependent communities. Policies restricting land uses in forests, especially in Asia, have contributed to forest populations.





3. The ecological effects of recovery of tree cover ('reforestation') differ with the type of vegetation, the previous land use/cover, and the relations between recovery at one place and ongoing deforestation elsewhere.

The environmental outcomes of tree recovery also vary greatly. Net tree cover increase may be concomitant with a continuing degradation or clearing of natural forests elsewhere, both within the country and abroad. International displacement of land use via the trade in agricultural and wood products reduces the global benefits of national policies to protect forests and promote reforestation (see ASB Policy Brief 17: Minang et al., 2010). The ecological benefits of tree cover transitions depend on the type of reforestation, its spatial pattern, previous vegetation covers, and on contextual factors. Secondary forests often provide valuable ecosystem services, especially in terms of carbon storage and hydrology, but not equivalent to those provided by primary forests. The benefits of agroforestry systems vary greatly depending on their type and the land use they replace. Tree plantations can have ecological benefits mainly on soil properties and hydrological flows -, if they are managed for that purpose, especially when established on degraded land and integrated in landscape mosaics. However, they often have negative ecological impacts, especially when large scale tree plantations replace ecologically diverse natural forests, swidden areas, natural grasslands or shrublands, and are managed intensively as monocultures of exotic species.

Data for Indonesia show that the nature of woody vegetation (fractions of district-level land cover) is closely linked to human population density, with agroforest and tree crop monocultures (incl 'forest plantations') replacing natural forest types at higher densities. An overall forest transition graph depends on definitions of forest and the types of woody vegetation included.

Xu (2011) commented on ecological problems caused by the way the China forest transition has been achieved.

4. Land use trajectories that avoid a low tree-cover phase and 'bypass' the high emission stages are often targeted in REDD+ policies; examples do exist and changes in land tenure regime are often key to change in tree cover.

Variations on figure 1 that suggest that low-C-stock phases in land use trajectories can be avoided (or 'bypassed') are frequently used in REDD+ discussions. As goal statement these portrayals may point towards options that do exist and can be realized. However, as the forest transition itself is not a 'Law of Nature' but an empirical regularity, discussions should focus on the removal of constraints to high-C-stock-highvalue land use systems (van Noordwijk et al., 2008a). In many countries tenure reform from state-controlled 'forest without trees' to other arrangements is needed before agroforestation can be expected. Historical examples of 'bypass' occur in the transitions of swiddens to agroforests rather than intensive annual cropping systems degrading into grasslands with frequent fire (van Noordwijk et al., 2008b).

Consequences and next steps

The 'forest transition' portrayal of patterns and trajectories of land use change has had a positive effect on public discourse in as far as it pointed to the partial reversibility of loss of tree cover, the shortcomings of linear extrapolations of historical

trends and the pessimism of a 'degradation' language. There is a risk, however, that existing data on the occurrence of turning points where tree cover starts to increase after a period of decrease are over-interpreted as a pattern that can be expected to emerge without specific policy change and attention.

"... a process of continuous change is unavoidable ...

A challenge in empirical approaches to 'forest transition' is that the pattern may be largely an artefact of the way forests are defined and data are collected. Various types of tree cover that can be expected at different human population densities (Fig. 3) can be grouped to obtain a forest transition curve, e.g. when the 'shrub/young secondary forest' is treated as non-forest, and the others as forest. Such ambiguities can be reduced if the graphs refer to quantitative tree cover rather than a dichotomy of forest/non-forest, but of course the issue of tree definitions is not trivial. Recent debate on whether or not palms are trees has implications for the forest definition. It may be more meaningful if the Y-axis is more closely related to functions rather than form: terrestrial carbon stocks, bioversity indicators, or correlates with measurable watershed functions. The correlations between these functional attributes are only partial and it urges policymakers to clarify what functions they really want from a landscape.

Beyond 'conservation', a process of continuous change is

unavoidable if essential parts of forest are to maintain their relevance and presence in the political, economic, social and ecological landscape. Forest transition theory and the empirical work it stimulates can help to progress the debates, without reverting back to mechanistic perspectives of fixed phases and predictable patterns.



Mixed agroforestry can replace forest or signify a return to permanent tree cover.

The ASB Partnership for the Tropical Forest Margins is working to raise productivity and income of rural households in the humid tropics without increasing deforestation or undermining essential environmental services.

ASB is a consortium of over 90 international and national-level partners with an ecoregional focus on the forest-agriculture margins in the humid and sub-humid tropics. The partners have established benchmark sites in the tropical forest biome of Brazil, Cameroon, Indonesia, Peru, Philippines and Vietnam.

The ASB Policybriefs series aims to deliver relevant, concise reading to key people whose decisions will make a difference to poverty reduction and environmental protection in the humid and sub-humid tropics.

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Further research and key references

- Lambin, E.F.; Meyfroidt, P. 2011. Global land use change, economic globalization, and the looming land scarcity. Proceedings of the National Academy of Sciences, 108 (9): 3465-3472, doi: 10.1073/pnas.1100480108
- Meyfroidt, P.; Lambin, E.F. 2011. Global Forest Transition: Prospects for an End to Deforestation. Annu. Rev. Environ. Resour. 36:343–71, doi: 10.1146/annurev-environ-090710-143732
- Minang, P. A.; van Noordwijk, M.; Meyfroidt, P.; Agus, F.; Dewi, S. 2010. Emissions Embodied in Trade (EET) and Land use in Tropical Forest Margins. ASB PolicyBrief 17. ASB Partnership for the Tropical Forest Margins, Nairobi, Kenya. Available at: www.asb.cgiar.org
- van Noordwijk, M.; Roshetko, J.M.; Murniati, Angeles M.D.; Suyanto, Fay C.; Tomich, T.P. 2008a. Farmer tree planting barriers to sustainable forest management. In: Snelder DJ, Lasco RD, eds. Smallholder tree-growing for rural development and environmental services: lessons from Asia. Advances in Agroforestry vol. 5. Berlin: Springer. p. 427–449
- van Noordwijk, M.; Mulyoutami, E.; Sakuntaladewi, N.; Agus, F. 2008b. Swiddens in transition: shifted perceptions on shifting cultivators in Indonesia. Bogor, Indonesia. World Agroforestry Centre ICRAF, SEA Regional Office. 48 p.

Xu, J.2011. China's new forests aren't as green as they seem. Nature 477: 371.

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