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Pitfalls for the sustainability of forest transitions: evidence from Southeast Asia

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Summary

The concept of a forest transition – a regional shift from deforestation to forest recovery – tends to equate forest area expansion with sustainability, assuming that more forest is good for people and the environment. To promote debate and more just and ecologically sustainable outcomes during this period of intense focus on forests (such as the United Nations' Decade on Ecological Restoration, the Trillion Trees initiative and at the United Nations' Climate Change Conferences), we synthesize recent nuanced and integrated research to inform forest management and restoration in the future. Our results reveal nine pitfalls to assuming forest transitions and sustainability are automatically linked. The pitfalls are as follows: (1) fixating on forest quantity instead of quality; (2) masking local diversity with large-scale trends; (3) expecting U-shaped temporal trends of forest change; (4) failing to account for irreversibility; (5) framing categories and concepts as universal/neutral; (6) diverting attention from the simplification of forestlands into single-purpose conservation forests or intensive production lands; (7) neglecting social power transitions and dispossessions; (8) neglecting productivism as the hidden driving force; and (9) ignoring local agency and sentiments. We develop and illustrate these pitfalls with local- and national-level evidence from Southeast Asia and outline forward-looking recommendations for research and policy to address them. Forest transition research that neglects these pitfalls risks legitimizing unsustainable and unjust policies and programmes of forest restoration or tree planting.

Introduction

Forests and trees are vital to the survival of human beings and the planet. They provide essential ecosystem services, such as climate regulation, water purification, biodiversity support and poverty alleviation (Brockerhoff et al. 2017, IPBES 2018, Miller et al. 2020). Southeast Asia, home to almost 15% of the world's tropical forest, has experienced rapid changes to its forests and tree cover, including widespread deforestation, expansion of commercial tree and agricultural plantations and a paradoxical mix of widespread degradation and concerted efforts at conservation and reforestation (Paradis 2021, Vancutsem et al. 2021). These changes have had profound ecological, social and economic consequences, including a loss of habitat and biodiversity, increased carbon emissions and transformed livelihoods and cultures (Sodhi et al. 2004, Miettinen et al. 2011, Fox & Castella 2013, Pichler et al. 2021). Rising incomes linked to higher economic productivity and new market opportunities are often contrasted with increasingly wasteful resource consumption and pollution problems, more pronounced marginalization of poorer or less privileged people (often women and ethnic minorities) and losses of cultural knowledge and identity (Nevins & Peluso 2008, Elias et al. 2022). Concerns over sustainability have led to growing interest in understanding the drivers of forest cover change and developing socially just and nature-friendly ways to reverse forest loss and degradation.

Governments as well as other actors (including non-governmental organizations (NGOs), the private sector, international organizations and bilateral aid agencies) have intervened through policy and actions that have shaped and will continue to shape changes in forests and tree cover (Estoque et al. 2019). These include logging or timber export bans, forest cover goals and mandates (Stanturf & Mansourian 2020), territorial zoning, biodiversity offset legislation and the declaration of protected areas (Déry & Vanhooren 2011). Other actions include creating structures for community-based forest management (Nguyen et al. 2022) or pursuing strong support for tree plantation development (Mansourian et al. 2017). Additionally, market-based mechanisms such as forest carbon credits under the United Nations' (UN) Reducing Emissions from Deforestation and Forest Degradation (REDD+) programme, voluntary market forest certification programmes and payments for ecosystem services are increasingly being used to incentivize sustainable forest management practices (Angelsen & Rudel 2013, Wunder et al. 2020, Tedesco et al. 2023). These efforts may lead to an increase in the area considered as forest, but even so, substantial governance challenges remain: natural forest loss and detrimental social outcomes for marginalized groups continue whilst structural drivers of forest loss remain unchallenged, highlighting the need for reflection in Southeast Asia and beyond.

Academic analyses of such forest changes and their driving forces have often turned to the concept of the 'forest transition', which describes a shift from forest loss to forest recovery in a particular region or country as that geographical area develops socially and economically (Mather 1992, Rudel et al. 2005, Meyfroidt & Lambin 2011). The historical occurrence of a forest transition has been described for various countries of the temperate zones in Europe and North America (Mather 2001b, Loran et al. 2016, Gingrich et al. 2022, Infante-Amate et al. 2022). Spontaneous forest regeneration there has often been an unintentional side effect of economic growth and modernization: rural-to-urban migration and increased agricultural field productivity led to the abandonment of marginal less productive lands, which then could revert to forest. In more recent decades, forest transitions have tended to involve more planned, concerted reforestation actions by governments concerned with resource degradation and conservation (Rudel et al. 2020). The forest transition is typically represented as a 'U-shaped' curve of forest cover, or forest biomass carbon stocks, over time (Fig. 1), although many people equate the term 'forest transition' with only the right half of the curve – that is, the recovery phase.

More recently, nascent forest recovery indicating a forest transition in tropical regions has led to excitement, particularly in parts of Central America (Kull et al. 2007, Redo et al. 2012, Jadin et al. 2016), the Caribbean (Walters 2017) and mainland Southeast Asia, notably Vietnam (Meyfroidt & Lambin 2008, Truong et al. 2017, Cochard et al. 2020, 2023, Pichler et al. 2021). However, such recoveries have not yet been seen in the three major tropical forest basins (the Amazon, the Congo and Sundaland: Borneo, Sumatra and Java as well as nearby islands such as Palawan and Mindanao). Current tropical forest transitions differ from previous ones in temperate zones in many ways, including much more proactive efforts by states and other actors, supported by international environmental policy efforts such as REDD+, the Bonn Challenge and other forest restoration targets (Stanturf & Mansourian 2020). There have also been strong influences of globalized trade connections (Mansfield et al. 2010, Meyfroidt et al. 2010, Lestrelin et al. 2013, Pendrill et al. 2019), human migration

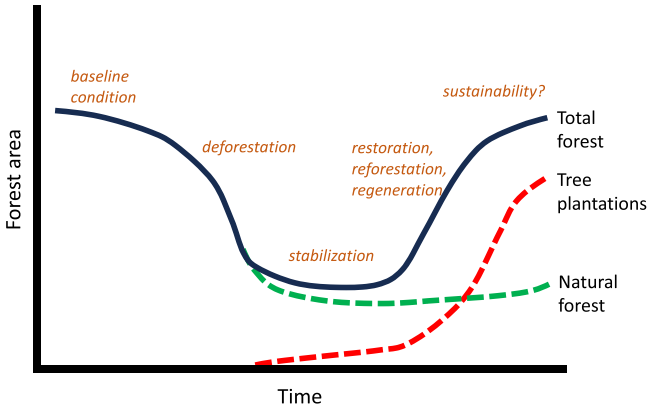

Figure 1. Idealized U-shaped 'forest transition' curve (Mather 1992, Rudel et al. 2005, Barbier et al. 2010, Sloan 2022, Cochard et al. 2023) showing the stages of total forest area in a particular region or country over time. The red and green dashed lines represent alternative curves if the two main components of 'total forest' (natural forests and plantation forests) are counted separately.

(Hecht et al. 2015, Oldekop et al. 2018), colonial legacies in land-use structure and governance (Rakotonarivo et al. 2023), rural growth and infrastructure development (Jimenez et al. 2022) and contrasting ecological conditions in species-diverse tropical forests as opposed to temperate forests dominated by few species (Montagnini & Jordan 2005).

The implicit assumption in forest transition research has often been that a forest transition rights the wrongs of past deforestation and contributes in diverse ways to sustainable development (Mather et al. 1998, Estoque et al. 2022, Cochard et al. 2023). This is doubly so in tropical forests, where catastrophic rates of deforestation have negative consequences for biodiversity, people and the global climate (Sodhi et al. 2004, IPCC 2019). The assumption that more forest is good at any cost (Mansourian et al. 2017) underlies the ways in which tree plantation programmes or campaigns (e.g., parts of the Bonn Challenge) formulate their goals spatially (in terms of numbers of hectares) or numerically (in terms of number of trees). For instance, the UN Food and Agriculture Organization (FAO) monitors progress on the UN's Sustainable Development Goal 15.2.1 ('progress towards sustainable forest management'). To do so, it uses three indicators related to governance and two physical indicators: total forest area and biomass stock (FAO 2020). Such overarching goals distract from secondary considerations for heterogeneity and adaptation to local conditions (Holl & Brancalion 2020, Coleman et al. 2021) and serve as a vehicle for government strategies to focus largely on commercially viable species to expand forest cover (e.g., in Vietnam; McElwee 2016).

However, the details are important. In Southeast Asia, for instance, forest cover increase often consists of monoculture plantations of non-native trees (Amat et al. 2010, Pichler et al. 2021), and the decline of natural forest continues (FAO 2020, Paradis 2021, Vancutsem et al. 2021), sometimes due to 'leakage' or displacement of demand across boundaries (Ingalls et al. 2018) or recurrent agricultural intensification linked to crop booms (Castella et al. 2023), but also because plantations are often unable to meet the demand for construction timber (offering lower-quality wood). We thus view the sustainability of forest transitions as multidimensional and multi-scalar. This necessarily brings forward questions of both ecology and justice (Scheidel & Gingrich 2020, Gupta et al. 2023, Rockström et al. 2023) and requires

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focusing on multiple ecological characteristics beyond forest area or biomass carbon stocks, and on multifaceted cultural and social characteristics beyond income or gross domestic product (GDP).

This paper investigates the pitfalls that future forest transition research should avoid in order to explicitly address the social and ecological sustainability implications of forest change. We do so to promote, support and suggest ways forward for research and policy towards more diverse transitions to sustainable forest use and management. Most use of the term 'forest transition' is in the sphere of academic research, yet the insinuations in such work that forest transitions are necessarily good can be used to validate interpretations, policies and political strategies regarding forests and tree planting (Angelsen & Rudel 2013, de Jong et al. 2017, Rigg et al. 2018, Leblond 2019, Zamora-López 2020). This is especially relevant given that stopping deforestation and encouraging forest recovery is a major pillar in numerous policy efforts at national and global levels, not least the three main Rio conventions (the Convention on Biological Diversity, the UN Framework Convention on Climate Change and the UN Convention to Combat Desertification) or the new European Union (EU) regulations on deforestation-free supply chains (EU 2023a). While recognizing that the forest transition lens provides a valuable heuristic for contextualizing and explaining changes in forest cover, especially in the face of ongoing tropical forest loss, non-critical forest transition research and policy formulation risk legitimizing policies and programmes of forest restoration or tree planting that are neither actually sustainable nor aimed at sustainable development in the multidimensional sense of being economically viable, equitable, socially just and ecologically sound.

We have identified these pitfalls through an interdisciplinary workshop held in early 2023 at the University of Lausanne. Participants were invited based on expertise in forest politics and ecology, with roots in multiple disciplines (including geography, anthropology, forestry, ecology, sociology, political science and economics). Most have long-term ethnographic research commitments in Southeast Asia and collaborations with in-country institutions. Research presentations were followed by brainstorming and structured reflections on forest transition. Taking inspiration from recent papers that have highlighted key lessons and trends for sustainable land management by listing rules, principles, facts or pitfalls (e.g., Sayer et al. 2013, Fleischman et al. 2020, di Sacco et al. 2021, Elias et al. 2022, Meyfroidt et al. 2022), combined with considering scholarship that highlights the potential consequences of the recent surge in sustainability transition and transformation discourses (Blythe et al. 2018, Scoones et al. 2020), we focused on pitfalls. Based on workshop outputs, the lead author consolidated an initial set of pitfalls, which were then revised and fleshed out by the rest of the team. For each pitfall, we describe a particular trap hidden in equating forest transitions with sustainability. Although the ideas apply to other world regions and outside the tropics, we provide evidence from Southeast Asia, including analyses at regional, national and local levels, and elaborate on the implications and ways forward for research and policy. The pitfalls are based on the field experiences and literature-based understandings of 15 experts and are one possible way of categorizing challenges for sustainability and justice related to the use of the forest transition concept – but by no means the only way. Together, the pitfalls described below show that sustainability is not a forgone conclusion and will require continued context-specific efforts and care. As such, the pitfalls can contribute to debates on the global campaigns for ecosystem restoration, conservation, climate change mitigation, environmental justice and Indigenous rights whilst also offering general lessons for more sustainable and just futures.

The pitfalls

Fixation on forest quantity as opposed to quality

States and conservation organizations often set quantitative goals for tree cover (Vietnam: 43% of national territory; Laos: 70% of national territory) or for trees planted (Vietnam's Five Million Hectare programme; Brunei's 500 000 trees planted by 2035; or the 'Trillion Trees' initiative of the World Wide Fund for Nature (WWF), Wildlife Conservation Society (WCS) and Birdlife International). Likewise, research on forest transitions frequently relies on relatively general forest cover statistics at broad scales and with insufficient distinctions of forest types (Riggs et al. 2018, Cochard et al. 2023). The areas of natural forests and tree plantations are generally reported up front in highly aggregate form as 'total forest' despite their drastically different ecosystem functions, as in the online Global Forest Watch data (WRI 2023) or the FAO's 5-yearly Global Forest Resources Assessments (e.g., FAO 2020). In the FAO's reports, after discussing 'total forest' area there is discussion of subtypes ('naturally regenerating' and two types of 'planted' forests) across regions, with further country data available online. However, the distinctions between forest types remain ambiguous (Matthews 2001, Mather 2005, Chazdon et al. 2016, Scheidel & Gingrich 2020, p. 682).

Forest coverage does not speak to its quality. While quantity refers to surface cover or numbers of trees, quality refers to a forest's socio-ecological characteristics such as species diversity and richness, size and age distribution of trees, flora and fauna populations, soil parameters and ecosystem functions, as well as the diverse values that humans attach to those characteristics (Dudley et al. 2006, Díaz et al. 2018). Different forests provide qualitatively different ecosystem services:

- *Biodiversity*. Monospecific exotic plantations provide neither the same habitat nor support the same species, biogeochemical flows or ecosystem processes from the canopy down to soils compared to biodiverse natural forests; indeed, that is not their purpose (Amat et al. 2010, Van Holt et al. 2016, Hua et al. 2022). Likewise, intact, structurally heterogeneous natural forests are more resilient in terms of biodiversity and ecosystem functioning than degraded or secondary ones, especially at altitude (Monge-González et al. 2021).
- *Climate regulation*. Forests play an important role in regulating regional and local climates (Watson et al. 2018). They can mitigate climate change through carbon sequestration, but they can also exacerbate it when they burn (Harris et al. 2021). Carbon sequestration and storage is affected by the type of forest and soils and the frequency and types of logging interventions (Mills et al. 2023).
- *Hydrology and erosion*. Forests mitigate flooding and erosion and attenuate dry spells, but the hydrological impacts of less disturbed natural forests differ from those of intensively used forests and even more so forest plantations (Creed & van Noordwijk 2018). For the latter, negative impacts are aggravated by cycles of bare soils and bulldozed access roads (Jones et al. 2022).
- *Economic goods*. Different forests provide different economic goods, from timber to diverse non-timber forest products (NTFPs), variably serving a broad range of users, including

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smallholders, labourers, subsistence households, people with forestry as a side activity, entrepreneurs, consumers, state entities and national and multinational corporations (Wunder et al. 2014).
- *Cultural services*. Different tree species and types of forests have varied aesthetic, socio-cultural and religious values (Ruelle et al. 2017, Santini & Miquelajauregui 2022).

The focus only on quantitative measures misses these crucial qualitative characteristics. Most claims of forest transitions in Southeast Asia appear to rely on the rapid expansion of industrial and smallholder tree plantations to compensate for natural forest decline that, despite slowing, continues (FAO 2020). Highlighting tree coverage can be explained by the proclivity for abstraction, ease of measurement, availability of statistics and fit to political or economic purpose but nonetheless obscures as much as it elucidates. Most current global targets for forests further encourage the emphasis on quantity (Mansourian et al. 2017), although there are exceptions that complement quantitative with qualitative measures, such as the EU's proposed Nature Restoration Law (EU 2023b).

Masking local diversity with large-scale trends

Academic analyses of forest transitions, just like governmental policy pronouncements, often focus on national and regional scales. Yet, changes aggregated at these scales often do not reflect changes in specific pixels, parcels or sub-regions. There is a diversity of patterns of forest change across Southeast Asia, and to adequately describe this diversity requires a contextual approach (Martin et al. 2023). Places that do not fit the broad pattern – marginal places, borderlands, shifting cultivation landscapes, interstices – are important, whether for people or for nature. For instance, on Palawan Island (Philippines), pockets of forests occupied by deities help nourish cultural traditions and sense of place in landscapes otherwise converted to industrial mono-cropped systems that alienate and suppress social and agro-ecological diversity (Theriault 2017, Dressler et al. 2018). In central Vietnam, war generally damaged forest cover but also allowed for forest recovery around some abandoned villages (Robert 2016). In war-torn Myanmar, deforestation trends in a single township varied widely according to the micro-politics of armed conflict actors (Woods et al. 2021). Diverse local patterns are interrelated with and constitute large-scale patterns in a dialectic way (Peluso & Vandergeest 2020). Often, positive changes in some locations take place at the cost of negative impacts elsewhere. This applies at the global scale as well, where protection and afforestation in some regions may exert deforestation pressure elsewhere (Winkler et al. 2021).

Expecting U-shaped trends of forest change

The idea of a U-shaped trend in forest area over time (Fig. 1) may be a useful concept around which to organize retrospective analyses of forest dynamics, particularly at large spatiotemporal scales. However, in practice, an observed end of deforestation may not automatically turn into forest recovery. Trends are stochastic, not deterministic; stepping onto the U-shaped curve is no guarantee that forest change will continue along the projected path. Forest growth is a long-term process influenced by many short- and medium-term political, economic and even biophysical factors such as fire or drought (Cochard et al. 2023). An iconic illustration from outside Southeast Asia is that the slowing of Amazonian deforestation in the early 2000s under Brazilian president Luiz Inácio Lula da Silva accelerated again under the next president, Jair Bolsonaro, and has slowed again with Lula's return to power (Machado Vilani et al. 2023) – rather than continuing along a constant curve of regeneration. In Indonesia, a rise in global demand for cheap oil drove a resurgence of forest losses due to deforestation for oil palm plantations (Rulli et al. 2019). Across Latin America, Sloan (2022) has also identified numerous 'hotspots' of reversals of afforestation trends.

Failing to account for irreversible loss

It takes a long time to replace the original qualities of destroyed or degraded 'natural' forests (defined as self-seeded native species forest) and their flora, fauna and soils. There may be tipping points beyond which a regime shift is difficult to reverse (Leadley et al. 2014, De Alban et al. 2019), and what may be lost along the way, such as certain keystone species, may have major repercussions for nature (Sodhi et al. 2004) and people (Reyes-Garcia et al. 2023). In central Vietnam, some areas deforested in the twentieth century due to war, logging or cultivation have not regenerated due to soil impoverishment or domination by persistent vine and bamboo thickets (Amat et al. 2010, Cochard et al. 2023).

Framing categories and concepts as universal or neutral

Forests and their definitions are inherently political (McElwee 2016, Peluso & Vandergeest 2020). How one defines, categorizes and counts forests and forest types can be contested terrain (Lund 2018). The common-sense or vernacular definition of forest as a relatively dense and large stand of trees is a good place to start for everyday communication. But for statistical and policy reasons, forest limits must be defined: which areas count, who defines the boundary and to which land does a forest policy apply? Diverse thresholds for counting land cover as forest may become contentious, including minimum size, tree height, density (canopy cover), species composition and land-use purpose (habitat, orchards, plantations, etc.). The FAO has famously updated its definition numerous times, affecting global statistics (Chazdon et al. 2016). Areas designated as forestland are not necessarily the same as lands counted as forest based on forest cover maps; indeed, land institutionally categorized as forests may in reality have no trees, and trees may grow on non-forest land (Lund 2002, Chazdon et al. 2016).

In Laos, for example, the categories 'forest' and 'forestland' can mean many things, ranging from old growth conservation forests to industrial tree plantations, from state forest estates for timber extraction to multifunctional landscapes that integrate local livelihoods with ecosystem services, to landscapes without trees (MRLG 2019). Whereas the FAO defines forests as land area with a tree canopy cover of more than 10%, national statistics in Laos set a minimum of 20% tree canopy cover. The latter seems to function mainly to exclude fallows from shifting cultivation counting as forests (Pichler & Ingalls 2021). The forest transition in Laos, like elsewhere, depends on politics and power relations that shape the prioritization, categorization and actual transformation of forest landscapes (Pichler & Ingalls 2021). A change in how forests are counted in Laos changed the overall statistical trend from deforestation to afforestation in 2015 (de Jong et al. 2017).

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Diverting attention from the simplification of forestlands into two categories

A focus on the forest transition may divert attention from a related transition in which 'lived forests' bifurcate into either 'conservation' or 'production' lands. 'Lived forests', in this sense, encompass ancestral territory, are actively managed and are used for swidden agriculture, NTFP collection and as riverine habitat. Historically, forests across Southeast Asia covered large areas and were managed as lived forests. In recent decades, swidden agriculture has declined whilst perennial and annual cash cropping has intensified (Cramb et al. 2009, Mertz et al. 2009, van Vliet et al. 2012, Dressler et al. 2017, Martin et al. 2023). Such land-use intensification makes possible the forest transition but with hidden ecological and social impacts (Cramb 2011, Gingrich et al. 2019, Pichler et al. 2021, Elias et al. 2022). Land classified as forest no longer includes many swidden forests and has moved to largely falling into one of two categories: conservation forests in which human land uses may be highly restricted and production forests organized around economic goals.

From the perspective of government officials, this simplification facilitates oversight, planning and modern economic development, but there can be diverse consequences (Scott 1998, Robbins 2001). The two new categories leave little space for locally based agroforestry livelihoods, for example. Mixed-use forest territories have become separate categories visible to state planners on national maps and orientated towards national and global goals, such as for global conservation or national hydropower interests in the case of protected forests or intensified forest land use for markets as in production forests. This constrains livelihood security and conservation objectives in multifunctional landscapes, as shown in the Philippines (Dressler et al. 2016). In Laos, land-use policies that favour the intensification of agricultural production have failed to end forest loss and food insecurity and have led to as much greenhouse gas emissions as continued shifting cultivation (Bauernschuster et al. 2022a).

Neglecting social power transitions and dispossessions

From conversion of tree cover to changes in classifications, forest dynamics are interconnected with who has the rights to access and use forestlands, who controls the decisions about how forestlands are used and who controls the stream of benefits from them (Phelps et al. 2010, Kull 2017, Pichler et al. 2022). These power dynamics may be gendered or related to ethnicity, wealth or other socio-economic and cultural differences. Notably, the bifurcation of lived forest into production and conservation forest (see above) often excludes local people from both forest types (Nguyen & Kull 2023, Pichler et al. 2022). There are winners and losers, and often widening disparities, in such transitions. This results in a transfer of power from a broader swath of local people to either state institutions for conservation or watershed forest management (perhaps with links to international environmental NGOs) or to industrial forestry or agribusiness actors (whether state and private forestry companies or local entrepreneurs and woodlot owners), as has been illustrated in Vietnam, Laos, Cambodia and Myanmar (To et al. 2015, Riggs et al. 2018, Pichler et al. 2021, Woods 2021, Vu et al. 2023). Such changes come with profound impacts on people, communities, cultures, ways of provisioning and social relations.

State forest and environmental bureaucracies of diverse types – from classical 'forest services' to state forest companies, parks agencies or ecosystem service funds – have become important in diverse regions where they did not previously act, exerting new sorts of rights and controls. Policies seeking to reduce deforestation, conserve forests and increase tree cover and forest restoration also achieve other goals, such as enrolling more people and land in a national economy or exerting control over national territory (Peluso & Vandergeest 2001, Fairhead et al. 2012, McElwee 2016) or Indigenous lands. Indeed, support for tree planting and forest protection – whether for nature conservation, carbon capture, economic development or general environmental improvements – can have political consequences, for example, by hiding or legitimizing displacement of villages for military control (Woods 2019, Woods & Naimark 2020, Nguyen & Kull 2023).

Social power transitions and exclusions often take place through mechanisms linked to land tenure, property systems and resource access (Ostrom 1990, Ribot & Peluso 2003). Forest transitions often involve a shift from customary, informal, common-pool governance institutions to different types and degrees of formalized property rights for states or private actors, like leases for large corporations or land titles to elite households (Youn et al. 2017, Pichler et al. 2022). The collective, customary land and resource rights of local communities often get trampled in this process (Hall et al. 2011, McElwee 2016, Pichler & Brad 2016).

Neglecting productivism as the hidden driving force

Forest transition theory has identified several 'pathways' to forest transitions, including economic development, state policy, forest scarcity, globalization and smallholder farming (Rudel et al. 2005, Lambin & Meyfroidt 2010, Riggs et al. 2018). However, in Southeast Asia, the dominant underlying driving force of forest changes is probably best characterized as 'productivism', or intensive, industrial, output-orientated economic activity (Mather 2001a, Neimark et al. 2016). This productivism operates across multiple pathways. For instance, the economic development pathway, which historically meant urbanization, industrialization and resulting rural land abandonment, is characterized in contemporary Southeast Asia by rapid transitions to capitalist and export-orientated cash crops (Hall 2011, Kröger 2014, Hirsch et al. 2022). In Laos, for example, 12% of the domestic land surface has been converted to agricultural and tree plantations or mining sites through large-scale land acquisitions since 2001, with diverse ecological and community impacts (Bauernschuster et al. 2022b, Magliocca et al. 2022). The state policy pathway – where governments push for a forest transition for wood supply and conservation goals – is also clearly partially productivist. For instance, Vietnam aggressively supports a growing export-orientated wood industry (Cochard et al. 2020) or voluntary market-based instruments for forest conservation that are based on offsetting productivist consumption elsewhere (Fisher et al. 2018). The smallholder pathway – which focuses on the role of small-scale farm households in promoting forested landscapes – can also become productivist. This is notably the case in Vietnam, where the acacia plantation boom is led by hundreds of thousands of smallholders keenly producing for profit (Nguyen & Kull 2023, Vu et al. 2023).

The consequences of productivism are multiple and diverse. On the one hand, productivism is tied to national economic development and rising incomes, at least for some. On the other hand, it is linked with the reordering of land tenure and social relations, social differentiation, excessive consumption,

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environmental degradation and notably an energy transition to fossil fuels and diverse hidden emissions (Gingrich et al. 2019, Pichler et al. 2021).

Ignoring local agency and sentiments

Action by people who inhabit forestlands and who have a political stake in land-use and forest policy is crucial to implementing, modifying, negotiating and reinterpreting state policy, and more broadly to forest change. The story of forest transitions cannot be told without understanding such people – often smallholder farmers (Rigg et al. 2016), but also part-time investors, labourers, local associations and NGOs – and their actions, constraints and wishes (Garcia et al. 2020). This includes paying attention to how people feel about changes in forests, forest livelihoods and forest policies and how people communicate and react to those changes from within their own worldviews. At a global level, the spiritual value of forests has changed its characteristics in concert with forest transitions (Roux et al. 2022). Such sentiments matter because they are part of human experience and influence how transformations are talked about, engaged with and ultimately acted upon. Exclusion of local communities and Indigenous people from thinking about and managing forest change can lead to conflicts and exacerbate deforestation (Fairhead et al. 2012, Sze et al. 2021), whereas their inclusion can yield not only positive social but also ecological benefits (Dawson et al. 2021).

In central Vietnam, the rural villagers who have become widespread acacia farmers have sometimes even been pushing into state-designated 'protection' forests to convert land to acacia plantations, but they have also been earning money by patrolling and managing natural forests. Through daily practices of growing acacia as well as caring for the forest, villagers not only interpret and apply state policy goals (and thus transform landscapes) but also cultivate plans and hopes for the future and a new sense of identity (Kull et al. 2023, Nguyen & Kull 2023, Vu et al. 2023). In the Philippines, upland farmers maintain swidden practices and forest livelihoods in ways that reflect, on the one hand, negotiations with state authorities and their representatives and, on the other hand, reciprocal relations with the community, deities and nature (Theriault 2017, Dressler et al. 2018, 2021). Local sentiments, knowledge and practices are central to fostering sustainable forest transitions – not only because local people are most directly affected by forest changes, but also because their sentiments and knowledge about the forest may actively contribute to fostering sustainable forest solutions (Shumi et al. 2023).

Implications

Forest transitions are often implicitly understood to be synonymous with sustainability transitions – that is, they are assumed to reflect, as an economy develops, a process that leads to a reduction in environmental degradation coupled with ecologically sound management for present and future use. This, however, remains an untested assumption across the tropics, as our evidence from Southeast Asia shows. Do forest transitions – regardless of their specific courses and underlying causes – indeed encompass transitions towards ecological regeneration, sustainable forest use regimes and resilient, socially just and economically viable systems in forestlands? The newly growing wood biomass is 'right' for whom? And how does one evaluate whether forest change was 'right' for the forest, the economy or the forest-dependent communities? As the pitfalls described above make clear, one needs to conceive of forest transitions as much more than a simple curve of recovering overall forest cover and instead look at a variety of patterns of change and transformation in forests and accompanying social, economic and political characteristics (Fig. 2). Our pitfalls are of course not exhaustive; they are meant to help with engagement in a critical conversation about the limits of forest transition-centred scholarship and policymaking that put the emphasis on quantity and to draw attention to the wide range of non-quantifiable contextualized conditions that require closer consideration in forest transitions.

The implications for research into the pitfalls we have highlighted (Fig. 2) are that research on forest transitions should attend to (1) a variety of indicators of the quality of forests and their internal patterns and dynamics, (2) the processes and drivers maintaining and transforming forest states and (3) the processes and values that lead individuals, society and institutions to make judgements of and act on these forest transformations. Furthermore, such research needs to be contextual, with attention given to local trends and local perspectives as well as higher-scale connections such as cross-border displacement, telecoupling, global value chains, uneven development and national and international conservation policies and actions. It should monitor social and ecological forest dynamics over the long term and be open to complex, contingent and non-deterministic changes. Finally, it should address questions of power, exclusion and justice (Sikor & Cam 2016, Pichler & Ingalls 2021, Hirsch et al. 2022).

With respect to policy implications, at a general level, the pitfalls suggest the need to build supportive and enduring policy frameworks for sustainable forestry that are both effective and perceived as just. Such frameworks should address the drivers of deforestation, forest degradation and expansive industrial tree plantations – and most notably those drivers linked to productivist economic pressures. They should focus on forest quality and be explicit on the qualities sought, why and for whom. They could, for instance, propose alternative solutions that harness and foster non-commercial values of natural forests and the rights of those stewarding them, especially local communities and Indigenous people.

The nine pitfalls lead to more specific policy implications as well (Fig. 2). Firstly, forest policies should steer away from acute abstraction with simple measures of quantity and emphasize instead transparent, multidimensional forest definitions (Scheidel & Gingrich 2020) and seek quality-orientated social, economic and ecological outcomes, as per the Kunming–Montreal Global Biodiversity Framework, the UN Sustainable Development Goals and other global priorities. A constant and explicit effort to monitor social and ecological forest dynamics and build supportive and enduring policy frameworks is necessary.

Secondly, the diversity and complexity of forest ecosystems and the difficulty in recreating that diversity once it has declined suggest the need for more effective conservation measures in forests harbouring valuable biodiversity, building on positive examples that combine conservation measures with social justice, such as some community forest management initiatives in the Philippines (Pulhin & Dressler 2009). The danger of irreversible loss makes clear that the assumption that some deforestation can be allowed because it would be reversed in the future is fallacious and points to the urgency of conservation in vulnerable native forests.

Thirdly, the politics behind forest management and change, from the choice of forest definition to the power dynamics between stakeholders, and the unrelenting role of productivism as a key

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	Pitfall	Research implications	Policy implications
1	Equating forest quantity with quality	Nuance measures of forest *quantity* to discuss what *qualities* are sought, why, for whom or for what.	Prioritize forest qualities important for habitat and local livelihoods.
2	Masking local diversity with large-scale trends	Complement global studies with attention to local trends and cross-scale linkages.	Emulate positive local trends and learn from negative ones.
3	Expecting U-shaped trend of forest change	Monitor forests continuously and research policy frameworks for long-term sustainability.	Build effective, just, and enduring policy frameworks for the long term.
4	Failing to account for irreversibility	Investigate risks of irreversible loss (social and ecological) through research on forests, people and driving forces. Attention to non-linear and complex dynamics.	Prioritize conservation in vulnerable forests. Foster non-commercial values of natural forests and the rights of those stewarding them.
5	Framing categories and concepts as universal/neutral	Be transparent in forest definitions and methodologies. Expose links between concepts and rhetorical or political goals.	Promote multidimensional forest definitions.
6	Diverting attention from the simplification of forestlands	Further investigate the implications of this simplification on ecology, livelihoods, and culture.	Defend 'lived forests' and broader-scale, multipurpose, sustainable agroforestry landscapes.
7	Neglecting social power transitions and dispossessions	Address questions of power, exclusion, and justice in research into forest transitions.	Focus policies on social safeguards, conditions of justice, tenure security, and supporting bottom-up forms of collective action in forests.
8	Neglecting productivism as the hidden driving force	Investigate productivist economic pressures as a crucial driver of forest change.	Support transformative change for sustainable forest governance underpinned by principles of social justice or alternative development models.
9	Ignoring local agency and sentiments	Facilitate local agency for a well-thought-out and just forest transition. Acknowledge and value multiple knowledge systems.	Create space for local communities and indigenous stakeholders in policy fora. Raise concerns about loss of cultural forest values. Recognize that forest policies, programmes and markets affect people very differently.

Figure 2. The nine pitfalls in equating forest transitions with sustainability and their implications for research and policy. Illustrations of dynamic forest landscapes across Southeast Asia, top to bottom: (a) plantations of rubber and acacia spreading in Nam Dong (central Vietnam), with remnant natural forest on hilltops; (b) ancestral lands of Pala'wan farmers on Palawan Island (Philippines); (c) announcement of an application for a communal land title for heritage land that has already been converted to oil palm plantations in Sabah (Malaysia); and (d) paddy rice fields and upland forest with swidden in Hsipaw (northern Shan State, Myanmar). Photo credits: (a) TNT, (b) WD, (c) JB, (d) KW.

driver require more all-encompassing policies. Policies should focus more on social safeguards, give due attention to gender and intersectionality, conditions of justice and tenure security and support bottom-up forms of collective action in forests. In Bhutan, for example, quality forest cover persists alongside improvements in social and economic development indicators (Bruggeman et al. 2016).

Fourthly, the bifurcation of forestlands away from lived forests to either production or conservation territories suggests advocacy and policies to defend multipurpose sustainable agroforestry landscapes, such as those highlighted as 'territories of life' by the Indigenous Peoples' and Community Conserved Areas and Territories (ICCA) Consortium (https://www.iccaconsortium.org). In the Lao uplands, multipurpose uses of agricultural and forest landscapes integrate diverse practices, including upland rice cultivation and the collection and partial commercialization of NTFPs, as well as permanent agriculture and tree planting (especially rubber and eucalyptus), in ways that can be consistent with traditional cultural and agro-ecological systems (Pichler & Ingalls 2021). Diverse ecological forests, managed for mixed use and conservation according to customary rules and regulations that are socially just and build peace, are also being promoted by Karen communities and supported by the Karen rebel group the Karen National Union (KNU) in the Salween Peace Park in south-eastern Myanmar (Equator 2018).

Finally, policymaking should bring in more diverse voices. Paying attention to local agency and sentiments also signifies facilitating policymaking spaces where local voices and advocacy are heard, just as, for instance, Indigenous people and local communities are becoming increasingly vocal stakeholders in global policy forums such as the Convention on Biological Diversity and the UN Framework Convention on Climate Change.

With attention being given to such dimensions, actors such as state policymakers and NGOs can seek to address multidimensional goals related to ecological sustainability, socio-economic development, justice and resilience not limited to tree cover or carbon. A quality forest transition that meaningfully links to sustainability is a forest transition that – following definitions of sustainable development – contributes to: (1) meeting the central human needs of current as well as future generations; (2) improved resilience of natural ecosystems and social systems to ensure sustained delivery of natural resources and ecosystem services whilst attending to a range of needs from multi-scaled economies and resource governance systems to local livelihoods and cultural traditions; and (3) socially just and equitable outcomes that address past wrongs and support the well-being of those historically marginalized from forestlands and their managed use.

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