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Policies Drive Sub-National Forest Transitions in Vietnam

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Received: 11 August 2020; Accepted: 18 September 2020; Published: 25 September 2020



Abstract: Vietnam has seemingly been able to shortcut the forest transition (FT) by quickly moving to the reforestation phase. Provincial-level forest cover and socio-economic trends are, however, not necessarily compatible with a standard FT framework. This article compares forest cover change and associated policy reforms in two provinces. Bac Kan is one of the poorest provinces in Vietnam, and has, after years of deforestation and forest degradation, expanded its forest cover during the past two decades. In contrast, Lam Dong province has higher GDP and population density, but has had high deforestation linked to expansion of perennial crops. This is contrary to what could be expected from a conventional FT hypothesis. Land use dynamics in Vietnam is heavily driven by its historical heritage related to the independence from French rule and heavy state-control and collectivization, and its more recent shift to “market-led socialism” (*doi moi*), involving export promotion, decentralization and land tenure reforms. The Vietnam experience shows that policies can trump the typical FT patterns linked to general development trends and structural changes, and that the typical FT-trajectory is not unavoidable. Yet, these policies have not primarily been guided by forest concerns, but should be viewed as a side effect of the *doi moi* policies pursuing economic growth and of the devolution of rights and decision-making.

Keywords: sub-national forest transitions; forest policies; economic development; Vietnam; *doi moi*

1. Introduction

The forest transition (FT) describes a development over time where an initially stable forest cover first declines sharply before it stabilizes and then slowly recovers [1]. Vietnam is an illustrative example of the FT, being one of few tropical forest countries that, over the past decades, have experienced a significant net increase in national forest cover [1–5]. The underlying drivers in the theorization of the FT are linked to economic development and broader structural transformations, yet the shift in Vietnam has largely been attributed to the large-scale reforestation and conservation programs carried out by the Vietnamese state in the 1990s and 2000s.

While Vietnam as a country is commonly viewed as an example of successful forest rehabilitation, the processes have varied greatly across its provinces [2]. Forest cover and land use dynamics are highly place-specific; both deforestation and reforestation processes can take place within the same country, making it difficult to talk about a national-scale FT [3]. The two study provinces represent contrasting stories of forest cover dynamics, making them an interesting comparative study. While Bac Kan has had a net increase in forest cover, Lam Dong has experienced a net loss over the past 30–40 years.

The article is guided by three sets of questions related to the current debate on the FT. First, to what degree can differing forest cover trends be explained by forest scarcity and general structural and economic transformations, as highlighted in the conventional FT story [4], or are they better explained by national and province-specific policies and institutions, as highlighted by other scholars [5]? Second, under the policy explanation, what is the relative role of general economic and development policies vis-a-vis targeted sectoral policies aimed at improving forest management and conservation? Third, at what scale does the FT apply? While there are trends in the direction of a “globalization of the forest transition” [6], to what degree is the FT (also) a useful framework to understand forest cover dynamics and policy implementation at sub-national levels? The article contributes to the FT literature by addressing these questions, first by reviewing the literature on structural and policy drivers, and then by contrasting of forest cover change and its drivers at sub-national scales, the latter rarely done in the FT literature. Further, it represents a practical application of conceptual outlines of the policy implications of the FT approach, as developed by, *inter alia*, Angelsen and Rudel [6].

The empirical strategy, mirrored in the outline of the article, is as follows: Section 2 outlines the conceptual framework of the study, focusing on the underlying theoretical FT perspectives. This part summarizes the literature on: (1) structural changes, (2) general policies, and (3) sector-specific policies that can drive the FT, i.e., move towards the reforestation phase. Section 3 introduces the national policy context, the two case study provinces and the data sources. Section 4 systematically compares the three sets of factors introduced in Section 2 with the actual structural changes and policies in Vietnam in general and the two study provinces. Throughout the article, we compare the contrasting development and policies in the two provinces. Section 5 synthesizes and concludes, arguing that the Vietnam forest cover story is about the decisive role of policies, which can modify or even overturn general FT predictions at both national and sub-national scales.

2. Conceptual Framework

2.1. Forest Transition and Its Drivers

The *forest transition* (FT)—as first introduced by Mather [1]—is characterized by a staged development in the forest cover. The early phase is defined by high forest cover and low deforestation rates. As the economy and the population start growing, deforestation rates increase and forest cover declines. Later, various processes (discussed below) lead to the turnaround, where reforestation and afforestation overtake deforestation, and forest cover starts increasing. The three stages are commonly termed: “core forest”, “frontier areas” and “forest-agricultural mosaics” [6,7].

Even though the FT model was initially developed to describe the historical forest cover development in Europe and North America, scholars have applied the concept to forest cover change in developing, tropical forest countries (e.g., Rudel, Bates & Machinguiashi [7], Rudel [8] and Rudel et al. [4]). Diminishing deforestation and emerging reforestation are now observed in a few tropical countries, particularly in South and East Asia and Central America [9,10].

According to conventional FT theory, there are two mutually reinforcing, transition paths: the economic development and the forest scarcity paths [4,11]. The *economic development path* suggests that economic growth brings higher off-farm income opportunities and therefore higher agricultural labor costs, which—combined with higher agricultural productivity—leads to the abandonment of agriculture on marginal lands, less pressure on forests and eventually the regrowth of forests. The *forest scarcity path* proposes that, with less forest, the demand for and value of timber and other forest products will increase. This could be an incentive for both better protection of forests against agricultural conversion, as well as expanding forest area either through natural regrowth or through planting (Figure 1) [6,12,13]. Within this framework, the forest transition can be viewed as a race between the agricultural rent and the forest rent [12]. In some contexts, however, higher demand for timber could also lead to unsustainable extraction and forest loss.

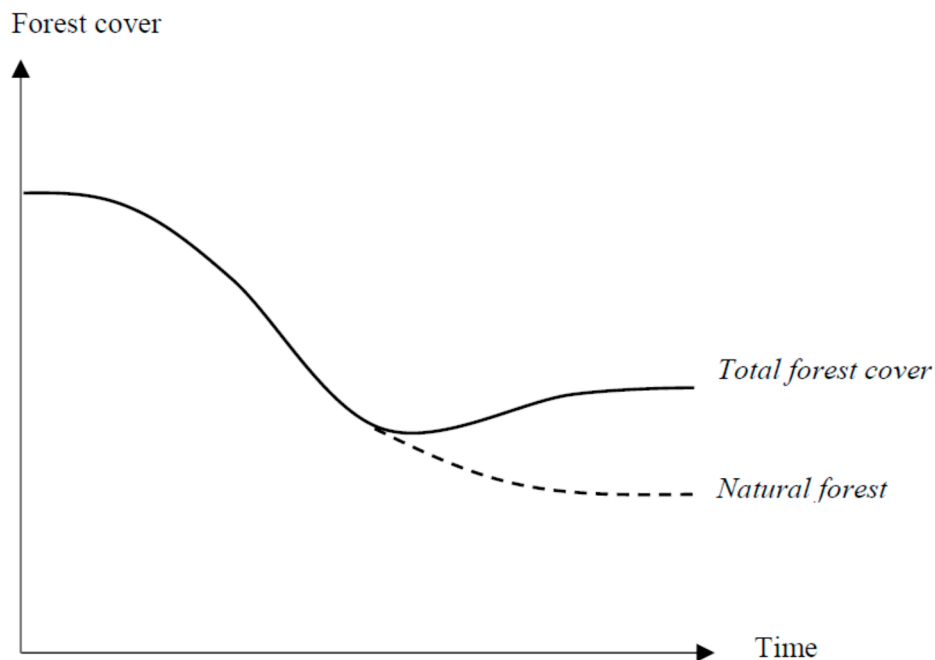


Figure 1. Forest transition curve and (potential) regrowth dynamics (figure based on various scholars, *inter alia*, Mather [1], Angelsen and Rudel [6], and Rudel [8]).

Angelsen and Rudel [6] extend this literature and define five possible drivers of the FT, by splitting the forest scarcity and economic development paths and adding policy changes in response to these. The drivers include: (1) scarcity of forest products, as a result of shrinking forest stocks and increasing demands; (2) scarcity of environmental services provided by forests; (3) diminishing agricultural rents from continued deforestation due to either longer distances and lower soil fertility on marginal lands; (4) economic development and structural changes, implying increasing (labor) production costs, changes in demands of forest and agricultural products; and, finally, (5) policy changes, including forest and agricultural sector-specific policies (e.g., direct lands use regulation, taxes and subsidies) and general policies (e.g., tenure and institutional reforms). We investigate the relative importance of these drivers to explain the forest cover development in the two study provinces.

2.2. The Appropriate Scale for FT Analysis

The question of the appropriate scale for the FT analysis is debated. Most FT studies have analyzed national-level forest cover dynamics [1,4,8], but recent studies of FT processes in Southeast Asia have claimed that FT is a more appropriate framework at higher geographical scales [14]. Lower deforestation rates in Vietnam can be linked to more deforestation in neighboring countries, including Cambodia and Laos [15], and international trade can bring about a “globalization of the forest transition” [6].

This article goes in the opposite direction and asks to what extent *sub-national* changes in forest cover can be understood within a FT framework. The predominant focus on national-scale mechanisms risks the neglect of important lower-scale processes related to household decision-making, which are highly diverse and crucial to understand the forest cover dynamics [7,16]. A diverse empirical evidence demonstrates the importance of taking contextual and historical conditions at sub-national scales into account in understanding forest cover dynamics [17–19].

The scale debate also relates to a deeper epistemological question: to what extent are broad theories useful even if they—by their very nature—ignore potentially relevant location-specific factors? At one level, the FT predictions are sufficiently vague to never be wrong; they do not specify the length of the initial stage of high and stable forest cover, the speed of deforestation, the minimum forest cover, nor how much forest cover that eventually will be recovered. Moreover, if one claims each space has

its own unique FT, comparison and testing become difficult. Yet, we hypothesize that FT (with all the modifications discussed) could be a useful lens to critically discuss to what extent there is a FT pattern and what types of policies and measures that have worked (and not worked) to improve forest management at sub-national levels in Vietnam.

2.3. The Role of Policies

The article is inspired by the *FT policy approach* framework of Angelsen and Rudel [6], who focus on how the FT can be used as a guiding framework for developing appropriate policies to reduce deforestation and forest degradation in contexts that are in different stages of the FT. The FT is not a deterministic prediction, but rather a forecast of how typical economic and demographic structural changes will affect forest cover over time. Policies matter and empirical evidence from Asia demonstrates that a FT is possible even when per capita income is still low, and that government policies have played a major role in shaping forest cover trends [11,20].

Since 2007, the main international, forest conservation effort has been through Reducing Emissions from Deforestation and forest Degradation (REDD+) initiative. The core idea of REDD+ is to reward individuals, communities, projects and countries that reduce greenhouse gas emissions [21]. The FT has been used to frame discussions about climate and forests, including policy reports on options for REDD+ and setting reference levels [22], as well as the general literature on deforestation and conservation policies [6,12].

Below we review in more details the potential impacts on land use and forest cover of: (1) structural demographic and economic changes, (2) general policies, which have non-forest primary objectives but potentially large forest impacts, and (3) forest sector-specific policies.

2.3.1. Structural Changes

Population growth: Higher population densities are likely to increase forest pressure through higher demand for cultivated lands. The contrasting Malthus and Boserup hypotheses take their turn along the FT curve [23,24]. While population growth and forest cover loss go hand in hand in the early FT phases in a Malthusian fashion, eventually farmers respond to higher population pressure and forest scarcity by intensifying production [23]. Higher agricultural yield may take some pressure off forests and other natural habitats, but the relationship is ambiguous [23]. Depending on the market conditions, farming constraints and type of production and crops, profit-maximizing farmers may look for more land to increase income while subsistence-oriented and labor-constrained farmers may go for intensification instead of extensification.

Economic growth: Economic growth is hypothesized to have a mixed—and stage-dependent—net effect on forest cover. Higher national income raises the demand for agricultural commodities as well as the capacity to invest in infrastructure, which stimulate deforestation in both the early and expansive “frontier” phase. Later, better agricultural technologies and growth in the off-farm sector will slow down deforestation. Nevertheless, the effects on forest cover at this stage are potentially contradictory. Higher labor costs could lead to the abandonment of marginal lands, and less forest may increase the value of forest products, creating incentives to reforest and actively plant new trees [4,25]. However, higher values of wood products may also lead to more unsustainable harvesting of timber in natural forests and forest degradation.

Governance: Governance conditions are also assumed to change and influence forest cover dynamics along the FT [6]. This is linked to, *inter alia*, government outreach, infrastructure development, relations between customary and statutory rights systems, and administrative capacities. The forest outcome still critically depends on the types of governance and context; good governance can both make policies for forest conversion more effective and forest exploitation more profitable, with ambiguous net effects [26].

2.3.2. General Policies

General policies refer to a wide group of laws and regulations and economic instruments (taxes, subsidies, etc.), which primary objectives are not forest-related but with potentially large forest implications, either by enabling or constraining forest conversion [27]. These policies include, *inter alia*:

Market liberalization: A move from a planned to a market economy and integration in a global economy provides new opportunities for agricultural production, affecting the incentives to clear forests. The impact on forest cover are still mixed: agricultural expansion could be stimulated, but higher demand for forest products may also provide incentives to plant more trees and permit forests to regenerate [12].

Infrastructure: The construction of new roads and improvements of already existing ones, are likely to facilitate forests and market access and, in turn, increase deforestation. Road construction is perhaps the most important explanatory factor for deforestation across countries and contexts globally [28]. Frequently, road construction is associated with wood extraction and agricultural expansion through forest conversion [29,30]. However, in later phases of the FT, infrastructure development might also be a precondition for effective reforestation policies [6].

Decentralization: Decentralization of forest governance refers to the transfer of decision-making processes, planning and other rights to sub-national levels. This has been a key trend in the Asia-Pacific region, including in Vietnam, since the early 1990s [31]. The documented positive effects of such policies on forest management are, however, scarce and the outcomes uncertain [32,33].

Tenure: Clarifying land rights and tenure may also have dual effects on forest cover trends. It may be an incentive for farmers to manage lands more sustainably and intensify production, and thereby reduce expansion into forests. However, tenure security may also be a precondition for expansion to claim new land [34]. Land titling requires complementary measures to effectively mitigate forest loss [27].

Agricultural policies: Agricultural subsidies and price policies have strong effects on the incentives to deforest or not. Subsidies to intensify agriculture may increase land rents, again with dual effects on forest cover. More targeted policies, that subsidize deforestation-preventing products and tax deforestation-driving products, or focus on intensification in non-frontier areas, can help take pressure off forests [35].

2.3.3. Sector-Specific Policies

Tree plantations: The forest scarcity pathway entails incentives to plant more trees as the forest cover shrinks. While tree planting in itself increases forest cover, the effects of reforestation policies on *natural* forest loss can still be ambiguous, depending the substitutability between natural forest and plantation wood [18]. Scarcity of wood products may drive degradation, particularly in frontier areas where property rights are unclear and the incentives for long-term forest management small. If forest degradation is due to logging of high-valued species, the planting of fast-growing exotic species is unlikely to generate any major positive conservation effects. Tree planting may also provide infrastructure and marketing opportunities that increase local prices for timber from natural forests.

Protected areas (PAs): Government-sponsored forest conservation include the establishment of national parks and measures to restrict human access to environmentally valuable areas. While there is solid evidence on the positive conservation outcomes of PAs [30,36], some of the favorable on-site effects might be offset by more pressure on areas outside of the PA [37].

Payments for Environmental Services (PES): The rationale behind PES schemes is that users of environmental services compensate the providers for managing the natural resources at stake [38,39]. Forest related PES and REDD+ must be seen as responses to a reduced supply of forest environmental services (e.g., water supply and forest carbon) [6]. Institutional factors such as clarified land rights are key to PES effectiveness [40], and such conditions are more likely to be found at the later (“mosaic”) stages of the FT [6].

3. Study Context and Data

3.1. The National Introduction of Market-Liberal Reforms

Vietnam is one of the few remaining single-party communist states in the world. After the independence from France in 1945, the communist government of North Vietnam nationalized all land and cooperatives became the basic management units for agricultural production [41]. The long history of communist cooperatives in the north makes the historical and socio-cultural setting very different from the south [42,43]. Since the unification after the Vietnam War (in Vietnam often referred to as the American War, by others called the Second Indochina War [44]), the Central Highlands have been part of the New Economic Zones (NEZ) program aiming to inhabit, develop and gain control over the central and southern parts of the country. Lam Dong province is part of the Central Highlands (together with Dak Lak, Dak Nong, Gia Lai and Kon Tum) and has consequently been exposed to heavy in-migration and land colonization, mainly by the majority Vietnamese (*Kinh*) people coming from the north of the country [44].

After years of misguided collectivization policies, resulting in food shortages, hunger, and widespread resistance from the rural populations [42], the government made a major turn in its economic policies in the mid-1980s. This is often referred to as *doi moi*—the “new shift” [45]. A key reform was to shift from collective to individual ownership for certain productive assets, including agricultural land [24]. The new agricultural policies also promoted market-oriented and intensified modes of production.

Rice is the most important crop in Vietnam. Historically, production was mainly organized as small-scale irrigated farms, using multiple cropping and labor intensive practices [46]. The *doi moi* policies changed this and introduced modern high-yielding and fertilizer-responsive varieties [47]. Rice production rose dramatically [41], and yield grew from 2.0–2.5 in 1980 to 3.0–5.5 tons per ha in 2002 [47]. By 2018, Vietnam was the fifth largest rice producer globally, producing 44 million tons [48].

The commercial production of perennial crops, such as coffee, rubber and tea, has also boomed. Coffee production has been particularly important in the Central Highlands, where *Robusta* production has increased tenfold since 1975 [49]. This expansion was also driven by *doi moi*, large-scale resettlements, land reforms and extension policies, in combination with favorable coffee prices during the 1990s [50].

The *doi moi* reforms also coincided with a public realization that the country’s forests were in poor conditions. Since the independence from French rule in 1945, forest cover had dropped from 43% to 27% in 1990 [44]. This spurred a series of policy programs aimed to reduce environmental degradation and stimulate forest regrowth on “barren lands” [51], including the so-called 327 and 661 reforestation programs. The names 327 and 661 refer to Government Decision numbers [52]. In the early 327 program, households received *green books* for forest protection and subsidies for planting of trees. In the 661 scheme (“The 5 Million Hectares Reforestation Program”), households got formal rights (*red books*) to the lands on which they planted trees [45]. In addition to reforesting the “barren lands”, the objectives were also to increase household income and reduce poverty in the country [52].

The programs also had components of forest protection. A national ban on logging was introduced in 1992. In areas where forests were perceived to be under threat, households were encouraged to sign up for so-called protection contracts. These included participating in patrol groups, led by forest rangers, to control illegal activities.

The 1993 Land Law (updated in 1999 and 2013) also opened up for forest land allocation to individual households and other “legal entities”, implying the rights to exchange (buy and sell), inherit, lease, and mortgage forest lands [51,53,54]. In certain areas, the position of State Forest Enterprises (SFE) also limited to what degree individual households received rights to forest lands [55].

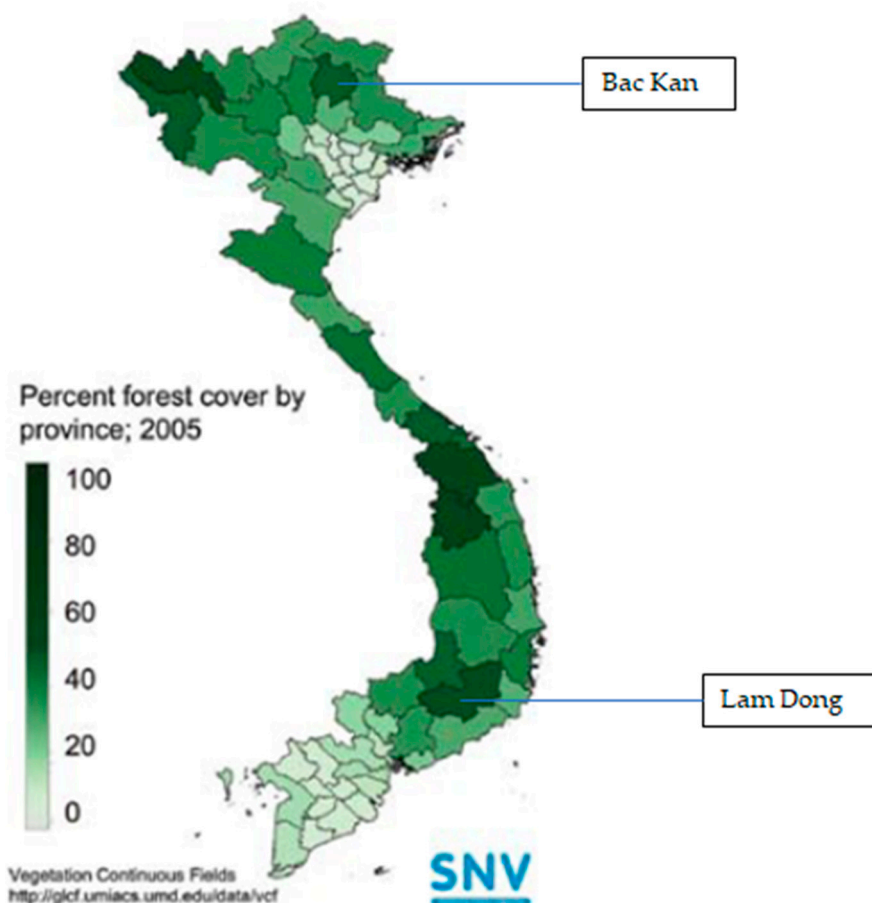
Vietnam’s forests are classified as *special use*, *protection* and *production* forests [56]. *Special use forests* include mostly national parks and areas set aside for special purposes, such as for research and tourism. *Protection forests* provide special types of services such as soil protection, water provision, and biodiversity and as protection against extreme weather events. *Production forests* are reserved

for plantations and planting of new forest. It is the dominant forest land category distributed to households, and allowed farmers to harvest certain types and amounts of forest products, including timber and fuelwood.

The policy reforms evolved at different speed and along different trajectories in different parts of the country [57]. The centrally developed reforms have been transformed and re-interpreted in the interplay with local-level socio-economic structures [57–60].

3.2. Study Areas

The study is based on a comparative case study approach, in which we compare forest cover trends and policy processes in two contexts in Vietnam: Lam Dong and Bac Kan provinces (see Scheme 1). Lam Dong is representative of a *frontier zone* where forest cover has been on retreat in recent decades [43], while the Bac Kan province represents a *forest mosaic* where a net forest-cover increase has taken place over the past 20 to 30 years [61]. The study sites illustrate the diversity and variations in historic, physical, cultural, political, economic and governance characteristics of the country. Both provinces have a relatively high forest-cover density and have been part of the national REDD+ pilot program, yet the forest cover change and policy interventions have been markedly different. In Lam Dong protection measures have been predominant, while in Bac Kan planting of trees has been a key policy intervention.



Scheme 1. Map of Vietnam, with forest-cover density (in 2005) and location of the case study provinces Bac Kan and Lam Dong (map retrieved from Holland and McNally [3]).

3.2.1. Lam Dong Province

Lam Dong is a landlocked province, characterized by its upland environments. The population is 1,288,200 (2016) with a population density of 132 per km². In 2015, the forest area was 532,100 ha, or 54.5% of a total area of 978,300 ha. Agricultural production is predominantly commercial (e.g., coffee and persimmon), in combination with subsistence crops (e.g., maize and cassava). Large-scale in-migrations from the north of Vietnam have shaped the recent history of the province. In addition, government resettlement schemes have aimed to convert the ethnic minority groups into sedentary lifestyles and to give up traditional shifting cultivation.

Due to the shorter history of communist rule (since 1975), Lam Dong was less affected by the initial years of collective policies, as compared to the Northern provinces. Nevertheless, Lam Dong was early considered one of the high-potential provinces in terms of forest resources, resulting in state control of forest land and large-scale logging by the SFEs. As a result, the SFEs and other government entities today control the major share of forest land, while households only have rights to about 1% of the forests [55].

3.2.2. Bac Kan Province

Bac Kan was established as a province in 1997. Its population was 319,000 in 2016, with a population density of 66 per km². The forest area in 2015 was 370,200 ha, making up 76.1% of the total land area of 486,000 ha. The province comprises of both lowland valleys, well suited for paddy rice production, and upland forested areas. Forest activities are often also combined with commercial tea production, maize and cassava.

Traditionally, the ethnic *Tay* have inhabited the lowlands, while various ethnic minority groups have been found in the uplands, practicing shifting agriculture inside of the forests. The collectivization policies introduced after independence in 1945 forced rural people towards rice production and sedentary life styles [62]. Much of the forests was lost during the post-colonial period, and since the early 1990s the province has been part of the large-scale government reforestation programs. The reforestation programs were mostly small-scale farmer driven, with the purpose of selling wood to local paper mills and plywood factories (owned by local authorities). The SFEs have played a relatively less important role in Bac Kan, and the land reforms allocated both agricultural and forest lands to individual households.

Given the FT framework and the characteristics of the two regions, we can hypothesize that the drivers will vary between the two provinces, as summarized in Table 1.

Table 1. Assumed drivers of forest cover change, based on the forest transition (FT) theory.

Frontier Areas (Lam Dong)	Forest-Agriculture Mosaics (Bac Kan)
Land scarcity	Forest scarcity
High economic returns on land (agric. land rent)	Environmental services scarcity
Environmental services scarcity	Economic development
Population growth	Diminishing agric. rents
Market integration	Urbanization

3.3. Data Sources

The article is primarily based on secondary data and publications, including official statistics and scientific publications. Publications on forest and agricultural management and forest cover change in the two provinces were systematically reviewed. In total, we reviewed more than 30 publications analyzing policies and agricultural and forest sector developments in the two provinces (see Appendix A for details). Data on forest cover change are from the Forest Inventory and Planning Institute (FIPI). Provincial forest cover data were publicly available for the 1999 to 2013 period. The FIPI data are collected by local forest rangers and officers, who report on the area of “natural” and “plantation”

forest, and areas that are burned, cleared, and planted over the past year. What constitutes a “forest” is outlined in Circular no. 34, and the definition includes typical criteria such as height (at least 5 m), canopy cover, and minimum area (at least 0.5 ha) [56]. In particular, certain types of perennial crops, such as coffee and tea, are left out of the forest definition; other types of commercial plantations, such as bamboo and rubber plantations, are included, in addition to timber plantations.

The processes driving deforestation and reforestation are only partly overlapping. We therefore calculated trends in deforestation by looking at the change in natural forest only. Net deforestation or reforestation is the sum of changes in the areas of natural and plantation forests. The main weakness of the selected approach is that in the collection of activity data on the ground, local authorities may have an incentive to “make things look good”, potentially biasing the data [63]. Modified forest definitions from 2012 in Bac Kan substantially affected the comparability between years. In addition, the current borders of the Bac Kan Province are recent, dating back to the end of the 1990s when Bac Thai province was split into the Thai Nguyen and Bac Kan provinces. We therefore focus on the 1999–2011 period. In FT terms, 12 years is a short period, but in combination with historic and narrative information about forest cover change, we can identify trends in forest cover change in the two provinces. In order to extend the time span, we also draw on other studies of forest cover change in the two provinces, including Meyfroidt, Vu, and Hoang [43] for the Central Highlands (Lam Dong) and Sadoulet et al. [64] for Bac Kan, as well as nation-wide studies such as van Khuc et al. [65].

A note on the institutional responsibilities for forest data is in order. The Ministry of Agriculture and Rural Development (MARD) has the responsibility of forest monitoring, and hence has the official forest data. These are based on on-the-ground reporting on the status of “natural forest” and “plantations”. This is also the data used for the analysis of provincial level forest cover trends in this study (Table 2).

Table 2. Forest cover change in Lam Dong and Bac Kan provinces, Vietnam, 1999–2011. Source: Forest Inventory and Planning Institute [66].

Province (Total Land Area, ha)	Forest Cover (ha)		Annual Change	
	1999	2011	ha	pct.
<i>Lam Dong (978,300)</i>				
Total Forest	618,537	598,192	−1695	−0.28
-Natural Forest	591,210	532,399	−4901	−0.87
-Plantations	27,327	65,794	3205	7.60
<i>Bac Kan (486,000)</i>				
Total Forest	235,247	296,947	5141	1.96
-Natural Forest	224,114	226,736	219	0.10
-Plantations	11,133	70,211	4923	16.59

We used official statistics on demography (population trends and urbanization), GPP level and change (economic growth), and agriculture and forestry developments (e.g., value of wood products). The General Statistics Office of Vietnam (GSO) was the main source of information here (https://www.gso.gov.vn/Default_en.aspx?tabid=491).

4. Results and Discussion

We first compare forest cover changes in the two provinces, before discussing the three sets of factors that can explain these changes (cf. Section 2.3): general development trends and structural changes, general policies that might be relevant for forest dynamics, and forest sector policies. Throughout the paper, we explore to what extent the observed changes fit into the FT theory’s predictions.

4.1. Forest Cover Trends

Comparing the forest cover over the 1999–2011 period (Table 2), confirms the presumed positive and negative trends in Bac Kan and Lam Dong, respectively. Bac Kan has earlier witnessed high deforestation rates, e.g., a case study in the Commune of Xuat Hoa documented a loss of 85% of the original forest cover over the period 1954–1998 documented through aerial photographs [64]. Since 1999, forest cover in Bac Kan rose by almost 2% annually. Through government policies to distribute production forest land to farmers, and incentivize the planting of trees, the area of plantations increased. Even though plantations contributed most of this increase, the area of natural forest in Bac Kan also grew. This may indicate that a turnaround in the FT has taken place, regardless of the government plantation efforts.

Lam Dong, on the other hand, saw an annual forest cover loss of 0.28%. The figures for natural forest loss was much higher, 0.87%; this rate is also high compared to the global gross tropical deforestation of 0.49% annually in the period 2000–2010 [67]. The difference between “total loss” and “loss of natural forest” is explained by a more than a doubling of the plantation areas in the province. Forest plantation policies have thus played a major role and contributed to weakening the negative forest cover trend in “frontier” Lam Dong. Nevertheless, if plantation forests have replaced natural forests, this could also have had a negative effect on the provision of major ecosystem services, such as “biodiversity preservation and carbon storage.

4.2. Structural Changes

Population growth: Populations have been increasing in both provinces. The population density is substantially higher in Lam Dong than in Bac Kan (Table 3), and so is the share of the population living in urban areas. This contradicts standard FT assumptions, namely that population densities and urbanization are lower in “frontier” areas than in “mosaics”. In Asia, the average population densities are 80 persons/km² in “frontier” as compared to 142 in “mosaic” zones [6]. Lam Dong (“frontier”) had a population density (2013) of 126 persons/km² compared to 62 in Bac Kan (“mosaic”). Demographic changes in Lam Dong have largely been migration-driven, both through resettlements and through voluntary migration. Between 1976 and 1980, 450,000 people were resettled to the Central Highlands, while 260,000 people moved during the 1981–1988 period [24]. Migration policies and agricultural colonization have been important in the modern Vietnamese state’s strategy of consolidating control over the periphery, such as in the Central Highlands [68]. This also caused the economic and political marginalization of indigenous groups, and the displacement of shifting agriculture to the forest margins [43,69].

Table 3. Population and economic development in Lam Dong and Bac Kan provinces, Vietnam, 1999–2012. Sources: General Statistics Office of Vietnam [70,71].

	Lam Dong (Frontier)		Bac Kan (Mosaic)	
	1999	2012	1999	2012
Population (‘000)	1005	1232	276	303
Population density (per km ²)	102.9	126.1	56.8	62.4
Monthly per capita real income (USD)	17.5	79.8	7.9	49.2

Economic growth: FT theory predicts positive correlations between economic growth and FT stage; higher income and diversification of the economy takes pressure off forests and make the forest cover eventually increase. Again, the recent development in two provinces does not correspond with those predictions. In Lam Dong, both income levels and growth in per capita income have been higher as compared with Bac Kan (see Table 3). Indeed, Bac Kan is one of the poorest provinces in the country [72], and households rely heavily on subsistence agriculture. In contrast, Lam Dong is known as one of the emerging economic provinces, linked to commercial perennial crops such as coffee, tea,

and rubber. Industrial development has also been faster in Lam Dong than in Bac Kan, where industrial production has decreased over the past years [73].

Governance: Only limited provincial level governance data are available. An exception is the provincial competitive index (PCI), developed and published by the business community in Vietnam. The PCI ranks provinces in terms of economic governance quality, and are based on factors such as entry costs, tenure security, transparency, informal charges, policy biases, and provincial leadership. Lam Dong (“frontier”) scored substantially higher than Bac Kan (“mosaic”) in 2014. Lam Dong was ranked 29 (*mid-high*), while Bac Kan was ranked 59 (*very low*) out of 63 provinces [74], indicating that governance cannot be directly linked to the differences in forest cover trends.

4.3. General Policies

Market liberalization: The most prominent shift over the past few decades has been from central planning to a market-oriented economy through the *doi moi* reforms. In rural areas across the country, the most pronounced effects were within the agricultural sector and related to the individualization of production and redistribution of land rights. The liberalization of agricultural prices, and production for both domestic and international markets, also had huge impacts. In the Central Highlands, the promotion of commercial coffee production in combination with favorable market trends, resulted in large in-migration and extensive expansion of coffee areas [49]. The trend in coffee area in Lam Dong indicates a link to global coffee prices (Figure 2). Nevertheless, Agergaard et al. [75] and others have demonstrated that frontier settlements and adaptations have followed more complex trajectories than a simple market-governed “boom and bust” model. Spatial and temporal variations were strongly affected by institutional and local settings, access to infrastructure, and the organizational setup of local coffee marketing chains. In addition, the ethnic majority *Kinh* demonstrated higher ability to diversify livelihoods and adapt to the collapse in coffee prices in the latter half of the 1990s than the ethnic minority households, who were more prone to neglect the maintenance of coffee trees in times of low coffee price [76].

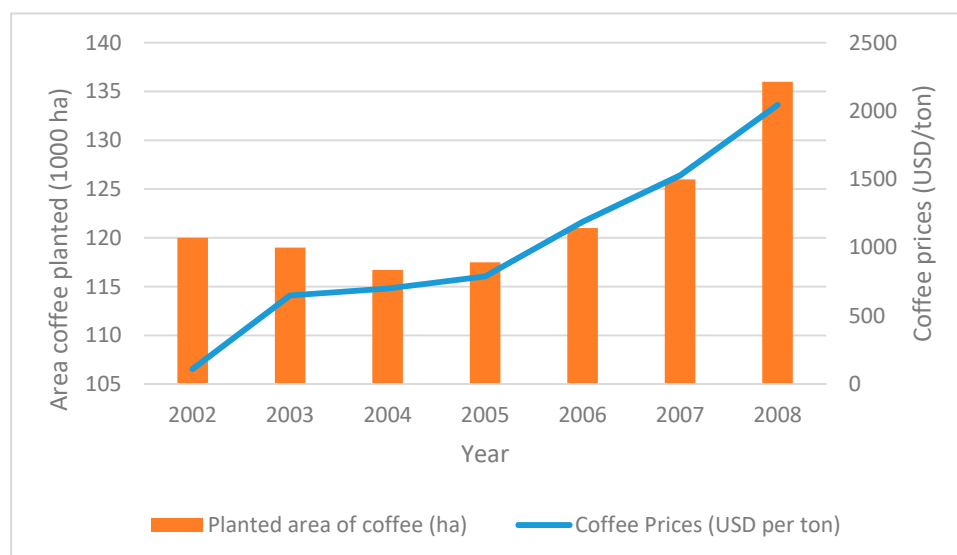


Figure 2. Changes in export prices and area of coffee production in Lam Dong Province, Vietnam. Source: Lam Dong Statistical Year Book 2008 [77].

During the years of collective production, rice was widely promoted among rural households, and ethnic minorities, practicing shifting agriculture, were forced into the collective system. The results were food shortage and illegal expansion into forests for upland rice cultivation. With *doi moi*, rice productivity rose, and continued increasing during the 1990s and early 2000s. Productivity in Bac Kan rose from 1.3 to 2.1 tons per ha from 1995 to 2013 [73]. The individualization of both agricultural

and forest land rights further discouraged migration and expansion of agriculture, lowering the pressure on forest lands [64].

Infrastructure: Data on infrastructure development and road construction at provincial levels in Vietnam are sparse. The total length of roads in the country doubled during the 1990–2008 period. Strategic roads through the Central Highlands and Lam Dong (including one through the Da Nhim Forest) made new areas accessible for commercial perennial crops, mostly coffee [78]. A study on the impact of this road expansion by Nguyen [63] suggests a dual effect: roads improve forest access and lower costs of land clearing, but also provides more diversified income opportunities that can relieve pressure on forests. Improved infrastructure also stimulated intensification of agricultural production and industrialization [79,80]. In Bac Kan, infrastructure development has been a precondition for the reforestation outreach programs, while isolation has facilitated continued cultivation on forest land. Overall, infrastructure development is likely to have facilitated the FT turnaround in Bac Kan.

Decentralization and tenure: Forest tenure and land use reforms have affected the provinces differently, as forest classifications and land right structures are quite distinct in the two provinces. About 80% of forest lands in Lam Dong are controlled by state entities (either State Forest Enterprises or provincial governments), and less than 1% of the forest rights rest with individual households. In Bac Kan, individual households manage about 58% of the forest land [55].

In Bac Kan, the changes in land use practices and the FT turnaround can largely be attributed to the land reforms of the late 1980s and early 1990s. The new land entitlements led to households' sedentarization, and to forest regrowth of land previously under shifting agriculture. The individualization of production and allocation of paddy land rights to households also led to more intensive land use, boosting input use and yield, and resulted in the abandonment of marginal land [62]. Tachibana, Nguyen, and Otsuka [41] found that new land rights in Bac Kan shifted resource use and investments away from clearing new land to already cleared fields. Forest land allocations also reduced the need to clear new lands in order to claim rights [81].

At the same time, population growth and marginalization of minorities from the paddy lands have implied continued cultivation of certain forest lands. After the decollectivization, the *Tay* reclaimed much of their ancestral lands that were confiscated during the collectivization period [64]. This left the other ethnic groups with only the allocated forest lands for productive purposes. As a response, agroforestry systems developed, in which households cultivated perennials and crops, often in a rotational system [62].

In Lam Dong, forest lands were to a very limited extent distributed to individual households, reflecting the high-value forest resources and productive soils to which state entities (such as the SFEs) wanted to maintain their rights. Unclear boundaries between forest and non-forest lands, and between the three forest categories, also contributed to unsustainable practices [82]. The confusion permitted powerful actors, such as rubber companies, to convert degraded forest lands into plantations [77]. Unclear tenure has also been an incentive for households to clear new land to claim rights [83]. The tenure ambiguities have thus been a key discussion point in the implementation of the Lam Dong PES pilot scheme [84]. Some claim that the prospect for PES revenue has provided incentives for the land owners to cement current structures [85].

Agricultural policies: Commercial coffee is the main crop and source of livelihoods in Lam Dong. Higher coffee yields on existing lands, in combination with intercropping of subsistence crops, is a key element of the provincial REDD+ strategy to reduce pressure on marginal lands [86]. Such a strategy is, however, far from being a guarantee for success. Higher productivity of the commercial crops might just stimulate further expansion. This is particularly risky for products sold in the global market, where the price-dampening effect of higher output is small [23]. The strategy thus needs to be combined with restrictions on expansion into forest land.

In Bac Kan, policies to intensify rice production, in combination with individualization of production and land rights, seem to have reduced pressure on marginal forest lands [58]. Yield-enhancing policies have included support to multi-cropping varieties of (spring) rice,

improved irrigation systems, fertilizers and pesticides [62]. This agricultural transition started already during the collectivization period, yet many farmers preferred to cultivate illegally in the forest hillsides. This, in turn, caused a situation of *de facto* open-access and extensive forest losses.

Rice intensification only took off after *doi moi* [64]. The downside of these policies was the dwindling of traditional highland production systems [87]. In addition, the sedentarization of households, individual land rights, combined with increased population pressures, have increased soil degradation and lowered profitability of shifting agriculture [81]. Reduced fallow periods and less flexible land rights systems (more individual based) have caused upland rice cultivation to become less sustainable [88].

4.4. Sector-Specific Policies

Regulation of logging: The 1992 logging ban caused an abrupt drop in Vietnam's timber production. Yet, since the mid-1990s, the volume of forest products has been on the rise in both provinces (Figure 3). The main actors in the forestry sector of Lam Dong are the SFEs, who receive annual timber quotas by the government [82]. In Lam Dong, the logging ban had contradictory effects, as it also resulted in higher timber prices and made illegal logging more attractive [77]. This illustrates the dual effects of forest scarcity; it may stimulate tree planting and other reforestation processes in some areas, but also lead to continued or higher forest exploitation in other places.

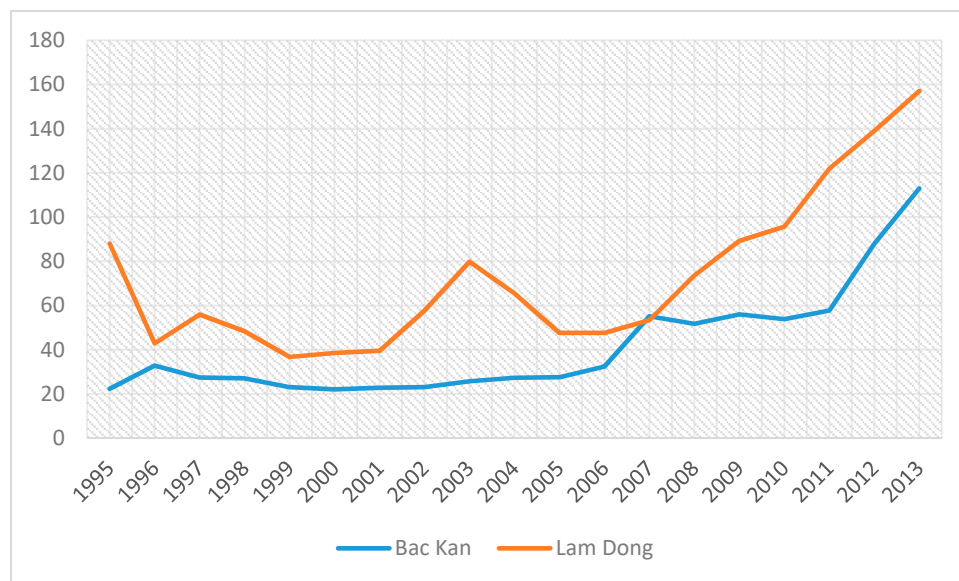


Figure 3. Gross production wood products (1000 m³) per year (1995–2013), Bac Kan and Lam Dong provinces, Vietnam. Source: General Statistics Office of Vietnam [73].

Tree plantations: Bac Kan is among the provinces that witnessed a dramatic fall in forest cover during the collective era [64]. Even though official policies emphasized the potential poverty reduction effects of forest plantations, these activities generated only limited income to farmers, especially the poorest segments [89]. Indeed, the tree planting policy was not primarily motivated by the long-term household benefits, but rather to enhance forest cover and provide environmental services (water and energy). Some also claim that the more subtle objective was to supply cheap inputs to powerful actors within the pulp-and-paper and plywood industries [45,90]. In this sense, the expansion of forest plantations in Bac Kan is in line with the forest scarcity hypothesis of the FT theory; booming demand for forest products within a particular sector, and the demand for environmental services, stimulate spontaneous or government-sponsored forest plantations. Nevertheless, a decline in both the areas of “rich natural forest” during 2005–2014 indicates that forest degradation is a significant challenge also in Bac Kan [91].

Protected areas: Forest protection measures were introduced in both provinces through the establishment of national parks. The areas of “special use forests” (strict protection) constitute about 13.4% of the forest area (78,525 ha) in Lam Dong and 7.7% (29,913 ha) in Bac Kan. Lam Dong has two nature reserves: Cat Tien National Park, established in the late 1970s, and Bi Doup Nui Baa, established in 2004. Bac Kan has one national park, Ba Be National Park (1992), which in 2011 also was designated as a Ramsar Site.

Studies do not show significant differences in deforestation and forest degradation between the national parks in Lam Dong and the surrounding areas [83]. The experiences from Ba Be National Park are similar; the only documented effect was the “passive protection” in the form of rugged limestone mountains in the core areas of the park, rather than the protection status itself [92]. The area of dense forests in the buffer zones and surroundings of Ba Be has decreased at the same rate as in the rest of the province.

PES: A number of environmental schemes has been tested and implemented in different parts of the country. Lam Dong has since 2008 been a pilot province for PES and since 2009 also for REDD+. Even though narrative information indicates that the number of violations has declined in the PES implementation zones of Lam Dong [45,93], the forest impacts of the PES scheme are uncertain. The opportunity costs of most livelihood activities are well above the current PES level of approx. USD 13 (VND 300,000) per ha. Unclear tenure and land rights have also been an issue for the distribution of PES. Since 2010, the PES scheme has been scaled up to the national level. Even though land tenure and land rights are more developed in Bac Kan, the PES scheme has so far not been implemented widely in the province.

PES in Vietnam has so far not been performance-based, which one might argue is a contradiction of terms. Ogonowski and Enright [94] estimated that with prices of USD 5 (VND 105,000) per tCO₂, PES would be competitive with most current land uses in Lam Dong, such as rice and coffee production. It would, however, face tougher challenges in competing with booming industrial crops such as rubber [43]. In order to succeed, PES will have to develop place-based approaches and differentiated payment based on local land uses and opportunity costs.

5. Synthesis and Conclusions

At the national level, Vietnam seems to fit nicely the predicted FT pattern: total forest cover has started to increase after decades of net forest loss. Such national trends conceal, however, contrasting developments at sub-national scales. First, the local biophysical settings differ, e.g., forest cover, soil, topography, and accessibility. Second, the local economic structure and institutions differ, e.g., the tenure regime. Third, the FT transition embodies drivers that may have mixed effects depending on context, as exemplified by the potential two-edged effect of agricultural intensification, which has both a forest conserving and a forest destroying potential. Fourth, policies interact with these broad drivers and contextual factors to co-determine forest outcomes. Fifth, many policies have, as documented in this article, been place-specific, strongly influencing the regional forest cover trajectories. In sum, even though patterns of sub-national FT can be discerned, they are driven by context-specific factors and policies that cannot easily be summarized into the standard FT pathways (Table 4).

In relation to the growing FT literature and debate on the role of structural drivers vs. policies, we highlight three lessons from the current study. First, the income level alone is not a reliable predictor of the stage in the forest transition. Bac Kan is further along the FT, in spite of being significantly poorer than Lam Dong. Bac Kan is one of the poorest provinces in Vietnam, population densities and the degree of urbanization are low, and subsistence (rice) production dominates. Failed collectivization policies made extensive and marginal production (shifting cultivation) more profitable, causing large-scale expansion and forest cover loss. Land tenure reforms and individualization of land rights from the mid-1980s, further reinforced by new and more intensified modes of production, depressed the agricultural rent (profitability) on marginal forest lands. This, in combination with the stimulation of tree plantations, contributed to a FT in Bac Kan. In contrast, the richer Lam Dong province seems

much more like a classical “frontier” area (maybe a late frontier) that fits the story from other countries well. The expansion of perennial commercial crops and a booming population—due to large-scale, state-sponsored migration—have been key drivers behind the forest loss. Several studies have also found clear linkages between global coffee prices and area expansion, confirming that high agricultural rent, in combination with forest access, is a very potent driver of forest loss.

Table 4. Post-*doi moi* (1986 onwards) policies relevant for FT and forest dynamics in Lam Dong and Bac Kan Provinces, Vietnam.

		Lam Dong (Frontier)	Bac Kan (Mosaic)
Structural changes and post- <i>doi moi</i> policies	<i>Population growth</i>	Land scarcity (–) Forest scarcity (more illegal activities) (?)	Land scarcity (–) Forest scarcity (+)
	<i>Commodity market</i>	Coffee price increase. Higher agric. rent	Development of a pulp and paper industry. Forest scarcity (more forest plantations) (+)
	<i>Urbanization</i>	Limited effect (0)	Limited effect (0)
General policies	<i>Market liberalization (late 1980s)</i>	New Economic Zone. Perennial crops for global market. Higher agric. rent (–)	Still subsistence oriented (paddy) (0)
	<i>Land tenure reforms (1991/1993)</i>	Devolution of agric. land rights/illegal expansion into forest land (–)	Individualization of land rights (both agric and forest) higher agric. rent (–) but also incentives for tree planting (+)
	<i>Migration policies (1975–)</i>	Extensive in-migration causing land scarcity (–)	Limited (0)
	<i>Agricultural policies</i>	Government support to perennial crop production (mid 80s). Higher agric. rents (–)	Intensification (2–3 crops per year) (mid 80s). Reduced agric. rent on marginal lands (+)
	<i>Regulation of activities</i>	Ban on logging: Reduced state-led logging, but more illegal activities (?)	Ban on shifting agriculture: Assumed positive, but continued illegal logging (?)
Sector-specific policies	<i>Tree plantations (1993/97)</i>	Limited/limiting negative trend of forest loss (+)	Tree planting (+)
	<i>Protected areas</i>	Establishment of national parks (2004/2005) (risk of leakage) (?)	Establishment of national parks (2011). Indirect effects due to terrain (risk of leakage) (?)
	<i>PES (2005)</i>	Intensified patrolling/control assumed positive. Opportunity costs outperform PES payments (+?)	Limited (not fully implemented) (0)

Key: + positive effects; – negative effects; 0 limited effects; ? unclear or ambiguous effects on forest cover.

Second, the role of different economic actors also needs to be revisited. Reforestation and afforestation efforts in Vietnam has been described as more small-scale-driven [45,95]. In the Vietnam context, however, the extensive reforestation that has taken place cannot solely be viewed from a small-scale producer’s perspective; it was also pushed and lobbied by the domestic pulp and paper, plywood and wood chip industries [45,90].

Third, the mixed effects of forest policies are noteworthy. Despite the frontier province (Lam Dong) having been more conservation-oriented than the mosaic one (Bac Kan), these policies seem largely to have backfired. The ban on logging and stricter conservation policies in Lam Dong increased scarcity of forest products, leading to higher timber prices and more illegal logging [77]. The tensions between conservation and agricultural development are also pronounced; policy objectives of agricultural production targets, economic development, and political control have undermined those of forest conservation and environmental services.

In short, the Vietnam forest cover story is about the decisive role of policies, and how they, in combination with local specific contexts, modify or even overturn general FT predictions. Studying sub-national FT processes may provide more fruitful inputs to practical policy-making than conventional national-level approaches. Further, in both our study provinces, the policies affecting forest cover have been embedded processes that relate to more general policy targets of societal change. The overall policy objective has been economic development policies in the form of market liberalization, individualization of land rights, and large-scale commercial agriculture. While this may serve to illustrate development–environment trade-offs, it also illustrates that the FT is not a natural law; the change in forest cover is greatly influenced, intentionally or not, by broader economic and development policies.

Author Contributions: Conceptualization, L.T.T. and A.A.; methodology, L.T.T. and A.A.; data curation, L.T.T.; writing—original draft preparation, L.T.T. and A.A.; writing—review and editing, L.T.T. and A.A.; supervision, A.A. All authors have read and agreed to the published version of the manuscript.

Funding: The research was made possible through financial support from the Norwegian University of Life Sciences (NMBU) and the Nansen Fund, managed by UNIFOR at the University of Oslo.

Acknowledgments: We like to acknowledge the invaluable support and advice provided by Manh Cuong Pham, the UN REDD Programme Office in Vietnam. We also thank Pham Thu Thuy, the Center for International Forestry Research (CIFOR) office in Vietnam, for comments and inputs to early drafts of the article. We also received constructive comments from two referees.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Overview of reviewed provincial topic-specific literature and data sources.

Theme	Lam Dong	Bac Kan
Forest developments	Data: www.kiendlam.org.vn Studies: De Koninck [44]; Meyfroidt and Lambin [15], Meyfroidt, Vu [43]	Data: www.kiendlam.org.vn Studies: Castella and Verburg [96]; Nikolic, Schultze-Kraft [97]
Tenure and land use planning	Studies: McElwee [85]; SNV [83]; Salemink [98]	Studies: Castella and Dang [58]; Tachibana, Nguyen [41]; Castella, Boissau [81];
Agriculture and forest policies	Studies: Déry [68]; D'haeze, Deckers [49]; Agergaard, Fold [75]; SNV [83]; Tran [93]; Hoang, Pham [99]; Tan [77]; [100]; McElwee [85]; Enright [101]; Ogonowski and Enright [94]; Meyfroidt, Vu [43]; Vu Tien Dien and Grais [82]; DARD [86]; Tinh, Tuan [102]; Trædal, Vedeld [84]; Trædal and Vedeld [69]	Studies: Pandey and van Minh (1998); Minot and Goletti [46]; Tachibana, Nguyen [41]; Zingerli, Castella [92]; Sadoulet, Castella [64]; Fatoux, Castella [62]; Castella, Boissau [103]; Bernard, Minang [104]; DARD [91]
General development	Data: GSO (<i>Living Standard Study</i>) [70]; PCI [74] Studies: Salemink [98]	Data: GSO (<i>Living Standard Study</i>) [70]; PCI [74] Studies: Castella, Manh [80]; Castella, Dang [105]; Castella, Tronche [106]

References

- Mather, A.S. *Global Forest Resources*; Belhaven Press: London, UK, 1990; p. 341.
- Meyfroidt, P.; Lambin, E.F. The causes of the reforestation in Vietnam. *Land Use Policy* **2008**, *25*, 182–197. [[CrossRef](#)]
- Holland, T.; McNally, R. *REDD Working Papers: REDD and Sustainable Development—Perspective from Vietnam*; IIED: London, UK, 2010.

4. Rudel, T.K.; Coomes, O.T.; Moran, E.F.; Achard, F.; Angelsen, A.; Xu, J.; Lambin, E.F. Forest transitions: Towards a global understanding of land use change. *Glob. Environ. Chang.* **2005**, *15*, 23–31. [[CrossRef](#)]
5. Bray, D.B.; Klepeis, P. Deforestation, forest transitions, and institutions for sustainability in southeastern Mexico, 1900–2000. *Environ. Hist.* **2005**, *11*, 195–223. [[CrossRef](#)]
6. Angelsen, A.; Rudel, T.K. Designing and implementing effective REDD + policies: A forest transition approach. *Rev. Environ. Econ. Policy* **2013**, *7*, 91–113. [[CrossRef](#)]
7. Rudel, T.K.; Bates, D.; Machinguiashi, R. A tropical forest transition? Agricultural change, out-migration, and secondary forests in the Ecuadorian Amazon. *Ann. Assoc. Am. Geogr.* **2002**, *92*, 87–102. [[CrossRef](#)]
8. Rudel, T.K. Is there a forest transition? Deforestation, reforestation, and development. *Rural. Sociol.* **1998**, *63*, 533–552. [[CrossRef](#)]
9. Southworth, J.; Nagendra, H.; Cassidy, L. Forest transition pathways in Asia—Studies from Nepal, India, Thailand, and Cambodia. *J. Land Use Sci.* **2012**, *7*, 51–65. [[CrossRef](#)]
10. Hecht, S. The new rurality: Globalization, peasants and the paradoxes of landscapes. *Land Use Policy* **2010**, *27*, 161–169. [[CrossRef](#)]
11. De Jong, W. Forest rehabilitation and its implication for forest transition theory. *Biotropica* **2010**, *42*, 3–9. [[CrossRef](#)]
12. Angelsen, A. *Forest Cover Change in Space and Time: Combining the von Thünen and Forest Transition Theories*; Policy Research working paper 4117; World Bank: Washington, DC, USA, 2007; p. 42.
13. Satake, A.; Rudel, T.K. Modeling the forest transition: Forest scarcity and ecosystem service hypotheses. *Ecol. Appl.* **2007**, *17*, 2024–2036. [[CrossRef](#)]
14. Meyfroidt, P.; Rudel, T.K.; Lambin, E.F. Forest transitions, trade, and the global displacement of land use. *Proc. Natl. Acad. Sci. USA* **2010**, *107*, 20917–20922. [[CrossRef](#)] [[PubMed](#)]
15. Meyfroidt, P.; Lambin, E.F. Forest transition in Vietnam and displacement of deforestation abroad. *Proc. Natl. Acad. Sci. USA* **2009**, *106*, 16139–16144. [[CrossRef](#)] [[PubMed](#)]
16. Perz, S.G.; Walker, R.T. Household life cycles and secondary forest cover among small farm colonists in the Amazon. *World Dev.* **2002**, *30*, 1009–1027. [[CrossRef](#)]
17. VanWey, L.K.; D’Antona, Á.O.; Brondizio, E.S. Household demographic change and land use/land cover change in the Brazilian Amazon. *Popul. Environ.* **2007**, *28*, 163–185. [[CrossRef](#)]
18. Sloan, S. Reforestation amidst deforestation: Simultaneity and succession. *Glob. Environ. Chang.* **2008**, *18*, 425–441. [[CrossRef](#)]
19. Aguilar-Støen, M.; Angelsen, A.; Moe, S.R. Back to the forest: Exploring forest transitions in Candelaria Loxicha, Mexico. *Lat. Am. Res. Rev.* **2011**, *46*, 194–216. [[CrossRef](#)]
20. Mather, A.S. Recent Asian forest transitions in relation to forest transition theory. *Int. For. Rev.* **2007**, *9*, 491–502. [[CrossRef](#)]
21. Angelsen, A. *Moving Ahead with REDD: Issues, Options, and Implications*; CIFOR: Bogor, Indonesia, 2008; p. 156.
22. Meridian Institute. *Modalities for REDD+ Reference Levels: Technical and Procedural Issues*; Prepared for the government of Norway; Meridian Institute: Washington, DC, USA, 2011.
23. Angelsen, A.; Kaimowitz, D. *Agricultural Technologies and Tropical Deforestation*; CABI Publishing in Association with CIFOR: Oxon, UK, 2001.
24. Müller, D. *Land use change in the Central Highlands of Vietnam: A spatial econometric model combining satellite imagery and village survey data*; Institute of Rural Development, Georg-August-University of Göttingen: Göttingen, Germany, 2003.
25. Rudel, T.K.; DeFries, R.; Asner, G.P.; Laurance, W.F. Changing drivers of deforestation and new opportunities for conservation. *Conserv. Biol.* **2009**, *23*, 1396–1405. [[CrossRef](#)]
26. Fontes, F.; Palmer, C. “Land Sparing” in a von Thünen Framework: Theory and Evidence from Brazil. *Land Econ.* **2018**, *94*, 556–576. [[CrossRef](#)]
27. Börner, J.; West, T.A.P.; Blackman, A.; Miteva, D.A.; Sims, K.R.E.; Wunder, S. National and subnational forest conservation policies: What works, what doesn’t. In *Transforming REDD+: Lessons and New Directions*; Angelsen, A., Ed.; CIFOR: Bogor, Indonesia, 2018; pp. 69–80.
28. Angelsen, A.; Kaimowitz, D. Rethinking the causes of deforestation: Lessons from economic models. *World Bank Res. Obs.* **1999**, *14*, 73–98. [[CrossRef](#)]

29. Geist, H.J.; Lambin, E.F. Proximate causes and underlying driving forces of tropical deforestation. *BioScience* **2002**, *52*, 143–150. [[CrossRef](#)]
30. Busch, J.; Ferretti-Gallon, K. What drives deforestation and what stops it? A meta-analysis. *Rev. Environ. Econ. Policy* **2017**, *11*, 3–23. [[CrossRef](#)]
31. Colfer, C.J.P.; Dahal, G.R.; Capistrano, D. *Lessons from Forest Decentralization: Money, Justice and the Quest for Good Governance in Asia-Pacific*; Earthscan: London, UK, 2008.
32. Larson, A.M.; Ribot, J.C. Lessons from Forestry Decentralization. In *Realizing REDD+: National Strategy and Policy Options*; Angelsen, A., Ed.; CIFOR: Bogor, Indonesia, 2009.
33. Wright, G.D.; Andersson, K.P.; Gibson, C.C.; Evans, T.P. Decentralization can help reduce deforestation when user groups engage with local government. *Proc. Natl. Acad. Sci. USA* **2016**, *113*, 14958–14963. [[CrossRef](#)]
34. Alston, L.J.; Libecap, G.D.; Mueller, B. Land reform policies, the sources of violent conflict, and implications for deforestation in the Brazilian Amazon. *J. Environ. Econ. Manag.* **2000**, *39*, 162–188. [[CrossRef](#)]
35. Rudel, T. Can a reduced emissions agricultural policy (REAP) help make REDD work? In *Realizing REDD: National Strategy and Policy Options*; Angelsen, A., Ed.; CIFOR: Bogor, Indonesia, 2009.
36. Spracklen, B.D.; Kalamandeen, M.; Galbraith, D.; Gloor, E.; Spracklen, D.V. A global analysis of deforestation in moist tropical forest protected areas. *PLoS ONE* **2015**, *10*, e0143886. [[CrossRef](#)] [[PubMed](#)]
37. Joppa, L.; Pfaff, A. Reassessing the forest impacts of protection. *Ann. N. Y. Acad. Sci.* **2010**, *1185*, 135–149. [[CrossRef](#)] [[PubMed](#)]
38. Wunder, S. Revisiting the concept of payments for environmental services. *Ecol. Econ.* **2015**, *117*, 234–243. [[CrossRef](#)]
39. Tacconi, L. Redefining payments for environmental services. *Ecol. Econ.* **2012**, *73*, 29–36. [[CrossRef](#)]
40. Alix-Garcia, J.; Sims, K.R.E.; Yañez-Pagans, P. Only one tree from each seed? Environmental effectiveness and poverty alleviation in Mexico's payments for ecosystem services program. *Am. Econ. J. Econ. Policy* **2015**, *7*, 1–40. [[CrossRef](#)]
41. Tachibana, T.; Nguyen, T.M.; Otsuka, K. Agricultural intensification versus extensification: A case study of deforestation in the northern-hill region of Vietnam. *J. Environ. Econ. Manag.* **2001**, *41*, 44–69. [[CrossRef](#)]
42. Kerkvliet, B.J.T. *The Power of Everyday Politics*; Cornell University Press: Ithaca, NY, USA, 2005; p. 305.
43. Meyfroidt, P.; Vu, T.P.; Hoang, V.A. Trajectories of deforestation, coffee expansion and displacement of shifting cultivation in the Central Highlands of Vietnam. *Glob. Environ. Chang.* **2013**, *23*, 1187–1198. [[CrossRef](#)]
44. De Koninck, R. *Deforestation in Vietnam*; International Development Research Centre (IDRC): Ottawa, ON, Canada, 1999.
45. McElwee, P. *Forests are Gold. Trees, People, and Environmental Rule in Vietnam*; University of Washington Press: Seattle, WA, USA; London, UK, 2016; p. 283.
46. Minot, N.; Goletti, F. *Rice Market Liberalization and Poverty in Vietnam*; International Food Policy Research Institute: Washington, DC, USA, 2000.
47. Ut, T.T.; Kajisa, K. The impact of green revolution on rice production in Vietnam. *Dev. Econ.* **2006**, *44*, 167–189. [[CrossRef](#)]
48. FAO. *FAOSTAT, Crops*; FAO: Rome, Italy, 2020.
49. D'Haese, D.; Deckers, J.; Raes, D.; Phong, T.; Loi, H. Environmental and socio-economic impacts of institutional reforms on the agricultural sector of Vietnam: Land suitability assessment for Robusta coffee in the Dak Gan region. *Agric. Ecosyst. Environ.* **2005**, *105*, 59–76. [[CrossRef](#)]
50. Nhan, D.T. Orientations of Vietnam coffee industry. In *Proceedings of the International Coffee Conference*, London, UK, 17–19 May 2001.
51. Long, V.; Vu, T.P. *Report on Review of Forestry Policies in Vietnam*; Research Centre for Forest Ecology and Environment: Hanoi, Vietnam, 2011.
52. SRV. *Vietnam Forestry Development Strategy 2006–2020*; Socialist Republic of Vietnam: Hanoi, Vietnam, 2007; p. 53.
53. Do, Q.T.; Iyer, L. Land rights and economic development: Evidence from Vietnam. In *Policy Research Working Paper*; World Bank: Washington, DC, USA, 2003.
54. Bayrak, M.M.; Tu, T.N.; Burgers, P. Restructuring space in the name of development: The sociocultural impact of the Forest Land Allocation Program on the indigenous Co Tu people in Central Vietnam. *J. Politi. Ecol.* **2013**, *20*, 37–52. [[CrossRef](#)]

55. UN-REDD. *UN-REDD Vietnam Phase II Programme: Operationalising REDD+ in Vietnam*; UN-REDD Programme: Hanoi, Vietnam, 2012.
56. SRV. *Circular No. 34/2009/TT-BNNPTNT of June 10, 2009, On Criteria for Forest Identification and Classification*; Ministry of Agriculture and Rural Development (MARD): Hanoi, Vietnam, 2009; p. 6.
57. Sowerwine, J.C. Territorialisation and the politics of highland landscapes in Vietnam: Negotiating property relations in policy, meaning and practice. *Conserv. Soc.* **2004**, *2*, 97–136.
58. Castella, J.C.; Dang, D.Q. *Doi Moi in the Mountains: Land Use Changes and Farmers' Livelihood Strategies in Bac Kan Province, Vietnam*; The Agricultural Publishing House: Hanoi, Vietnam, 2002.
59. Clement, F.; Amezaga, J.M. Afforestation and forestry land allocation in northern Vietnam: Analysing the gap between policy intentions and outcomes. *Land Use Policy* **2009**, *26*, 458–470. [[CrossRef](#)]
60. Trædal, L.T.; Vedeld, P. Cultivating forests: The role of forest land in household livelihood adaptive strategies in the Bac Kan Province of northern Vietnam. *Land Use Policy* **2018**, *73*, 249–258. [[CrossRef](#)]
61. Do, T.H. *Who is Planting or Removing Trees?* ICRAF: Hanoi, Vietnam, 2014.
62. Fatoux, C. From Rice Cultivator to Agroforester Within A Decade: The Impact of Doi Moi On Agricultural Diversification in a Mountainous Commune of Cho Moi District, Bac Kan Province, Vietnam. In *Doi Moi in the Mountains: Land Use Changes and Farmers' Livelihood Strategies in Bac Kan Province, Vietnam*; The Agricultural Publishing House: Hanoi, Vietnam, 2002.
63. Nguyen, N.L. National reforestation, regional deforestation? Cross-boarder timber trade and forest transition in Vietnam. In *School of Economics and Business*; Norwegian University of Life Sciences: Ås, Norway, 2013.
64. Sadoulet, D. A short history of land use changes and farming system differentiation in Xuat Hoa Commune, Bac Kan Province, Vietnam. In *Doi Moi in the Mountains: Land Use Changes and Farmers' Livelihood Strategies in Bac Kan Province, Vietnam*; Castella, J.C., Dang, D.Q., Eds.; The Agricultural Publishing House: Hanoi, Vietnam, 2002.
65. Van Khuc, Q.; Tran, B.Q.; Meyfroidt, P.; Paschke, M.W. Drivers of deforestation and forest degradation in Vietnam: An exploratory analysis at the national level. *For. Policy Econ.* **2018**, *90*, 128–141. [[CrossRef](#)]
66. FIPI (Forest Inventory and Planning Institute). 2013. Available online: www.kemintran.vn (accessed on 19 January 2015).
67. Achard, F.; Beuchle, R.; Mayaux, P.; Stibig, H.J.; Bodart, C.; Brink, A.; Carboni, S.; Desclée, B.; Donnay, F.; Eva, H.D.; et al. Determination of tropical deforestation rates and related carbon losses from 1990 to 2010. *Glob. Chang. Biol.* **2014**, *20*, 2540–2554. [[CrossRef](#)]
68. Déry, S. Agricultural colonisation in Lam Dong Province, Vietnam. *Asia Pac. Viewp.* **2000**, *41*, 35–49. [[CrossRef](#)]
69. Trædal, L.T.; Vedeld, P.O. Livelihoods and land uses in environmental policy approaches: The case of PES and REDD+ in the Lam Dong Province of Vietnam. *Forests* **2017**, *8*, 39. [[CrossRef](#)]
70. GSO. *National Living Standard Survey*; General Statistics Office: Hanoi, Vietnam, 2012.
71. GSO. *National Living Standard Survey*; General Statistics Office of Vietnam: Hanoi, Vietnam, 2006.
72. Hoang, M.H.; Do, T.H.; Pham, M.T.; Van Noordwijk, M.; Minang, P.A. Benefit distribution across scales to reduce emissions from deforestation and forest degradation (REDD+) in Vietnam. *Land Use Policy* **2013**, *31*, 48–60. [[CrossRef](#)]
73. GSO. *Statistical Data*; General Statistics Office of Vietnam: Hanoi, Vietnam, 2016.
74. PCI. Ranking-Chart PCI 2014. 2014. Available online: <http://eng.pcivietnam.org/bang-xep-hang?f2=0&index=0&year=2014> (accessed on 8 September 2016).
75. Agergaard, J.; Fold, N.; Gough, K.V. Global-local interactions: Socioeconomic and spatial dynamics in Vietnam's coffee frontier. *Geogr. J.* **2009**, *175*, 133–145. [[CrossRef](#)]
76. Ha, D.T.; Shively, G.E. Coffee boom, coffee bust and smallholder response in Vietnam's central highlands. *Rev. Dev. Econ.* **2008**, *12*, 312–326. [[CrossRef](#)]
77. Tan, N.Q. Environmental services in Vietnam: An analysis of the pilot project in Lam Dong Province. In *Forest Conservation Project*; Occasional Paper; Scheyvens, H., Ed.; IGES: Kanagawa, Japan, 2011.
78. World Bank. *Vietnam: Aligning Public Spending with Strategic Priorities in the Forestry Sector*; The World Bank Rural Development, Natural Resources and Environment Department East Asia and Pacific Region: Washington, DC, USA, 2009.

79. Alther, C. Impact of accessibility on the range of livelihood options available to farm households in mountainous areas of northern Vietnam. In *Doi Moi in the Mountains. Land Use Changes and Farmers' Livelihood Strategies in Bac Kan Province, Vietnam*; Castella, J.C., Dang, D.Q., Eds.; The Agricultural Publishing House: Hanoi, Vietnam, 2002.
80. Castella, J.C.; Manh, P.H.; Kam, S.P.; Villano, L.; Tronche, N.R. Analysis of village accessibility and its impact on land use dynamics in a mountainous province of northern Vietnam. *Appl. Geogr.* **2005**, *25*, 308–326. [[CrossRef](#)]
81. Castella, J.C.; Boissau, S.; Thanh, N.H.; Novosad, P. Impact of forestland allocation on land use in a mountainous province of Vietnam. *Land Use Policy* **2006**, *23*, 147–160. [[CrossRef](#)]
82. Dien, V.T.; Bay, P.N.; Stephen, P.; Chau, T.V.; Grais, A.; Petrova, S. *Land Use, Forest Cover Change and Historical GHG Emission, From 1990 to 2010, Lam Dong Province, Vietnam*; USAID: Hanoi, Vietnam, 2013.
83. SNV. *Cat Tien—How forbidden is the “Forbidden Forest”?* SNV: Hanoi, Vietnam, 2010.
84. Trædal, L.T.; Vedeld, P.O.; Petursson, J.G. Analyzing the transformations of forest PES in Vietnam: Implications for REDD+. *For. Policy Econ.* **2016**, *62*, 109–117. [[CrossRef](#)]
85. McElwee, P. Payments for environmental services as neoliberal market-based forest conservation in Vietnam: Panacea or problem? *Geoforum* **2012**, *43*, 412–426. [[CrossRef](#)]
86. DARD. *Action Plan On “Reduction of Greenhouse Gas Emissions Through Efforts to Reduce Deforestation and Forest Degradation, Sustainable Management of Forest Resources, and Conservation and Enhancement of Forest Carbon Stocks” in Lam Dong Province, Period 2014–2020*; Lam Dong People Committee: Dalat, Vietnam, 2014.
87. Castella, J.C.; Erout, A. Montane paddy rice: The cornerstone of agricultural production systems in Bac Kan Province, Vietnam. In *Doi Moi in the Mountains: Land Use Changes and Farmers' Livelihood Strategies in Bac Kan Province, Vietnam*; Castella, J.C., Dang, D.Q., Eds.; The Agricultural Publishing House: Hanoi, Vietnam, 2002; pp. 175–196.
88. Pandey, S.; Van Minh, D. A socio-economic analysis of rice production systems in the uplands of northern Vietnam. *Agric. Ecosyst. Environ.* **1998**, *70*, 249–258. [[CrossRef](#)]
89. Sikor, T. *Financing Household Tree Plantations in Vietnam: Current Programmes and Future Options*; Center for International Forestry Research (CIFOR): Bogor, Indonesia, 2011.
90. Lang, C. *The Pulp Invasion: The International Pulp and Paper Industry in the Mekong Region*; World Rainforest Movement: Montevideo, Uruguay, 2002.
91. DARD. *REDD+ Provincial Action Plan: Reduction of Emissions From Deforestation, Degradation, Sustainable Management of Forests, Conservation and Enhancement of Forest Carbon Stocks in Bac Kan Province, in the Period Of 2016–2020*; Dickson, B., Ed.; Department of Agriculture and Rural Development: Bac Kan, Vietnam, 2016.
92. Zingerli, C. Contesting policies: Rural development versus biodiversity conservation in the Ba Be National Park area, Vietnam. In *Doi Moi in the Mountains: Land Use Changes and Farmers' Livelihood Strategies in Bac Kan Province Vietnam*; Castella, J.C., Dang, D.Q., Eds.; The Agricultural Publishing House: Hanoi, Vietnam, 2002.
93. Tran, K.T. *Socio-Economic Survey for Assessing the VN Government Policy on Payment for Environmental Services for Lam Dong Province*; Asia Regional Biodiversity Conservation Program: Ho Chi Minh City, Vietnam, 2010.
94. Ogonowski, M.; Enright, A. *Cost Implications for Pro-Poor REDD+ in Lam Dong Province, Vietnam: Opportunity Costs and Benefit Distribution Systems*; IIED: London, UK, 2013.
95. McElwee, P. Reforesting “bare hills” in Vietnam: Social and environmental consequences of the 5 million hectare reforestation program. *Ambio* **2009**, *38*, 325–333. [[CrossRef](#)]
96. Castella, J.C.; Verburg, P.H. Combination of process-oriented and pattern-oriented models of land-use change in a mountain area of Vietnam. *Ecol. Model.* **2007**, *202*, 410–420. [[CrossRef](#)]
97. Nikolic, N.; Schultze-Kraft, R.; Nikolić, M.; Böcker, R.; Holz, I. Land degradation on barren hills: A case study in northeast Vietnam. *Environ. Manag.* **2008**, *42*, 19–36. [[CrossRef](#)] [[PubMed](#)]
98. Salemink, O. *The Ethnography of Vietnam's Central Highlanders: A Historical Contextualization 1850–1990*; Routledge Curzon: London, UK, 2003; p. 383.
99. Hoang, H.C. *Participatory Rural Appraisal for the Project for Strengthening Community-Based Management Capacity of Bidoup-Nui Ba National Park*; Department of Social Forestry and Agroforestry, Nong Lam University of Ho Chi Minh City: Ho Chi Minh City, Vietnam, 2011.
100. To, P.X.; Dressler, W.H.; Mahanty, S.; Pham, T.T.; Zingerli, C. The prospects for payment for ecosystem services (PES) in Vietnam: A look at three payment schemes. *Hum. Ecol.* **2012**, *40*, 237–249. [[CrossRef](#)] [[PubMed](#)]
101. Enright, A. *The Lam Dong REDD+ Pilot Area, Vietnam: A Socioeconomic Baseline Survey*; IIED: London, UK, 2012.

102. Tinh, B.D.; Tuan, T.H.; Tran, P. Evaluation of the impact of pilot payments for forest environmental services (PFES) in Lam Dong Province, Vietnam. In *Climate Risks, Regional Integration, and Sustainability in the Mekong Region*; Lebel, L., Ed.; Sumernet, Stockholm Environment Institute, Strategic Information and Research Development Centre: Petaling Jaya, Malaysia, 2014; pp. 270–284.
103. Castella, J.C.; Boissau, S.; Trung, T.N.; Quang, D.D. Agrarian transition and lowland–upland interactions in mountain areas in northern Vietnam: Application of a multi-agent simulation model. *Agric. Syst.* **2005**, *86*, 312–332. [[CrossRef](#)]
104. Bernard, F. *Towards a Landscape Approach for Reducing Emissions: Substantive Report of Reducing Emissions from All Land Uses (REALU) Project*; World Agroforestry Centre–ICRAF: Nairobi, Kenya, 2013.
105. Castella, J.C. Scaling up local diagnostic studies to understand development issues in a heterogenous mountain environment: An introduction to the SAM Program. In *Doi Moi in the Mountains: Land Use Changes and Farmers' Livelihood Strategies in Bac Kan Province, Vietnam*; Castella, J.C., Dang, D.Q., Eds.; The Agricultural Publishing House: Hanoi, Vietnam, 2002.
106. Castella, J.C.; Tronche, N.R.; Vu, N. Landscape changes in Cho Don District during the doi moi era (1990–2000) and their implications for sustainable natural resource management in Viet Nam's mountainous provinces. In *Doi Moi in the Mountains: Land Use Changes and Farmers' Livelihood Strategies in Bac Kan Province, Vietnam*; Castella, J.C., Quang, D.D., Eds.; The Agricultural Publishing House: Hanoi, Vietnam, 2002.



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