Economics of natural forest transition and sustainable forest management

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Abstract

Sustainable forest management (SFM) is the management of forests based onthe principlesof sustainable developmenthypothesizedas anoutcome of forest transition theory (FT), asproposed by Mather. The current study theorizes economic forest sustainability as "the forest-related income and economic well-being sustained over time". It is centered on the organizational approach and the conceptual framework in several forest sectors in various regions. Socio-economic drivers play a very significant role in forest transition. The study describes numerous factors playing a critical role in forest transition. Conversely, without an efficient institutional framework and strategies, a transition is not likely to happen and the legislative efforts for SFM in order to reduce deforestation will remain restricted. Subsequently, further approvedfrom the study of economics of natural transition and SFM employed in various successful countries. The present studyextends the understanding ofeffective forest transition which is critically based oncentralize and susceptible policies of SFM.

Keywords: Economics, deforestation,forest transition, reforestation, sustainableforest management

1. Introduction

Societies tend to convert fertile forest lands into fields and pastures for cultivation and other purposes which pose a continuous ecological and climate impacts on forest decline as experienced in many countries. Forest transition is a shift from net deforestation to net reforestation(FAO, 2010; Lambin, 2010).

The term SFMwas established by the Ministerial Conference on the Protection of Forests in Europe (MCPFE) and adapted byFood and Agriculture Organization (FAO) defines sustainable forest management as:"The economic management and use of forests and forest lands in a way and rate to sustain their biodiversity, productivity, renewal capacity, life and their strengthto fulfill relevant ecological, economic and social functions, at local, national, and global levels without damaging to other ecosystems".In simpler terms, it is best described as the balance between social norms and forests in relation to the benefits on both sides by preserving forest health and diversity. This balance is significant to the survival of forests, and to the fortune of forest-dependent communities (FAO, 2001; Seto, 2005; MCPFE, 2011; Ezeali, 2015).

In the last fifty years, the significance of forests and their relationships to the communities have been associated with forest management and these efforts in many countries are replaced in the 1970s and 1980s by SFM. Increasing levels of deforestation led to policy experiments with positive influence on net deforestation. The importance of biodiversity and of forests as the pools of terrestrial biodiversity led to a rapid and 11 unprecedented expansion of protected areas such that they now cover more than 10% of the global land surface (Vira et al. 2015).

The term forest transition was first coined in by geographer Alexander Mather to define an empirical uniformity observed in various countries, explicitly a national-scale shift from a reducing to an expanding forest area.The theory of a forest transition, being a transformation from net deforestation to net reforestation as determined by land specialism was originallysuggested by Mather (1992).

Whereas countries of the Worldwide North practiced a forest transition between 18th and 20th century (Mather & Needle, 1998). The validationafter this is double. Primarily, forests offersignificant environmental facilities at a local level such as water holding, checking soil overspill and providing timber and non-timber forest products (NTFPs) for the local population (Grebner et al. 2013). Secondary, at a global rank forests are, as wellas oceans, the most essential sink of CO_2 (IPCC, 2014b) and deforestation and forest deprivation is responsible for more than 17% of the total human-based CO_2discharges (IPCC, 2007). Table 1 shows the results of various studies of the financial profitability of SFMin tropical forests.

Table 1: A summary of the results of various studies of the financial profitability of SFMin tropical forests

Study	Results
Reid and Howard, (1994)	Unsustainable logging in Guatemala is substantially (21-55 percent) more profitable than logging operations with sustainability considerations.
Hardner and Rice,(1997)	SFMpractices in Pará (Brazil) are evidently financially lesser than unsustainable practices.
Bruenig, (1990)	Timber liquidation generates the highest profits in Sabah, Malaysia.
Kollertet al. (1995)	Estimation of the financial returns from eight SFM options tested in Malaysia, specify that they all produce positive results, but that these are also lower than could be obtained in the short-term through unsustainable practices.
Howard and Valerio, (1996)	Financial returns from SFMare competitive compared with those of cattle ranching and crop production in three regions of Costa Rica. However, defying this conclusion, evidence shows that unsustainable forest practices continue. The authors attribute this to the comparatively undesirable patterns of cash flows generated by SFM practices, to the lack of land ownership security and to sheer ignorance about the financial benefits of SFM.
Mendoza and Ayemou, (1992)	The analysis of several forest management options in Côte d'Ivoire reveal that sustainable harvesting reduces profitability considerably compared with a strategy of resource depletion.
Howard et al. (1996)	A simulation model of the Chimanes forest in Bolivia shows that sustainable practices will reduce profitability by 35-67 percent.
FAO (1997)	A case-study in the Brazilian Amazon shows that reduced impact

	logging and other more sustainable harvesting techniques increase costs, but only slightly. It also suggests that future benefits may compensate for these costs in the long-run.
Kishor and Constantino, (1993)	Analysis of four competitive alternative uses of forest land in Costa Rica show that the "cut and run" forest depletion option is the most profitable one and far more profitable than the SFM option.
Johns et al. (1996)	Study of Paragominas Region (Brazil) shows that reduced impact logging (involving directional felling, climber cutting, improved planning and less waste) is profitable. These measures increased the net present value of the timber harvest by 34 percent.

The present study aims to evaluate the natural forest transition from net deforestation to net reforestation by presenting the FT and the importance of forests on low and wide scale level as well as the design of assessment categories.

1.1 The role of forests and the importance of a forest transition

1.1.1 The global context and climate change

Beginningwith the global level environmental services, there is a surprising emission of CO_2 from human based industrial activities and forests play a critical role for absorbing this enormous amount of lethal CO_2 emissions which is responsible for global greenhouse effect (Grebneret al. 2013). $1/5^{th}$ of the total human CO_2 emissions is absorbed by highly vulnerable tropical forests alone (Science 18 Daily, 2009). Likewise, in forest cover, i.e. deforestation and forest degradation transitions are accountable for 17.4% of CO_2 emissions from industries and other resources (IPCC, 2007). Therefore, reforestation and afforestation activities are crucial for reducing the emissions from the Land use, land-use change and forestry (LULUCF) sector.

1.2The principle of forest transition

The principle of forest transitions was originallyoffered by Mather in the beginning of the 1990s (Mather, 1992). As discussed by Mather and Needle (1997), in numerousadvanced countries the area of forests is accumulating after periods of degeneration. Essentially, in the progression of expansion, a common characteristic is followed by developed, and recently also by some developing countries (Barbier et al. 2010). In this process, the forest area declines in

periods of massive population growthwhich is related with the excessive food requirement and new social settlements. A small shift producing big transitions is reached by a leverage point (Meadows, 1999) and this tendency gets overturnedby passing time (Barbier et al., 2010). This process has been occurred in most of the developed world, with Western European countries having their forest transitions empowering the second half of the 19th century (Mather, 2007), Japan in the 18th century and South Korea in the mid-20th century.

Forest transition is a long run forest change which covers an immense global expanse (Perz, 2007). This process is driven by various factors with a perpetual transition impacts. Particularlyduring time of developing environmental and climate concerns recognizing these factors, or drivers, is significant (Mather & Needle, 1998). This type of transition occurs on various scales beginning from a very basic local level, and raging through national to a global scale (Pagnutti et al., 2013).

1.2 Deforestation

The world is experiencing a global deforestation with tree covered areas declining every year i.e. experiencing net deforestation. Barbier et al. (2010) described main drivers of deforestation in various countries worldwide.

- Market policy fiascos, i.e., downgrading of incentives for clear cutting of forests.
- Over exploitation of forest lands or of old-grown forest covers for other human activities.
- Poor regulations leading to deforestation.
- Unsatisfactory leasing treaties for economical forest management.
- Manipulation of forest covers for fuel wood and transitional cultivation practices on productive forest lands.

Shortly, the most important driver of greatest annual deforestation in various countries in the world (Figure 1) remains the change of land-use from forest land to agricultural land being driven by the growing population and the development of global markets (Pagnutti et al., 2013), as well as the poor institutional framework: inadequate regulations, lacking capacities and

corruption (Mather & Needle, 1997; Barbier et al., 2010). Another, indirect driver, mentioned by Perz (2007) is that deforestation is also partially determined by the North-South power division resembling the colonial times, in which the colonies were oriented on the export of natural resources being exploited on an unsustainable manner. Deforestation can be determined by the foresttransition model with impacts on global forest covers (Figure 2) (UCSUSA,2014).

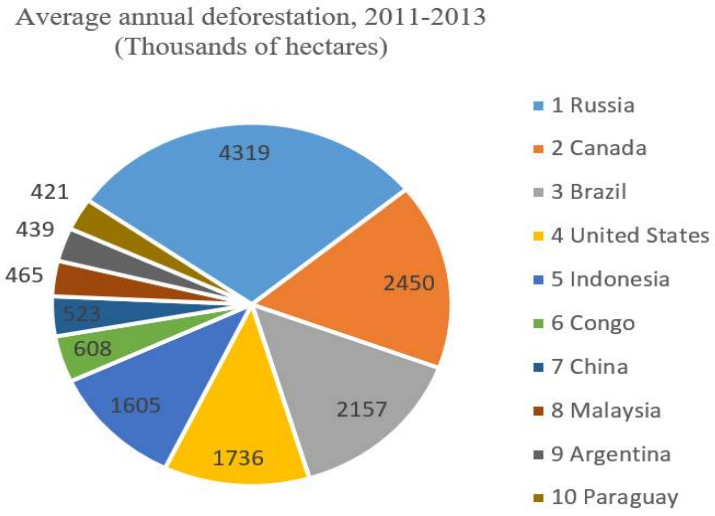

Figure 1. Countries with highest average annual deforestation 2011-2013.

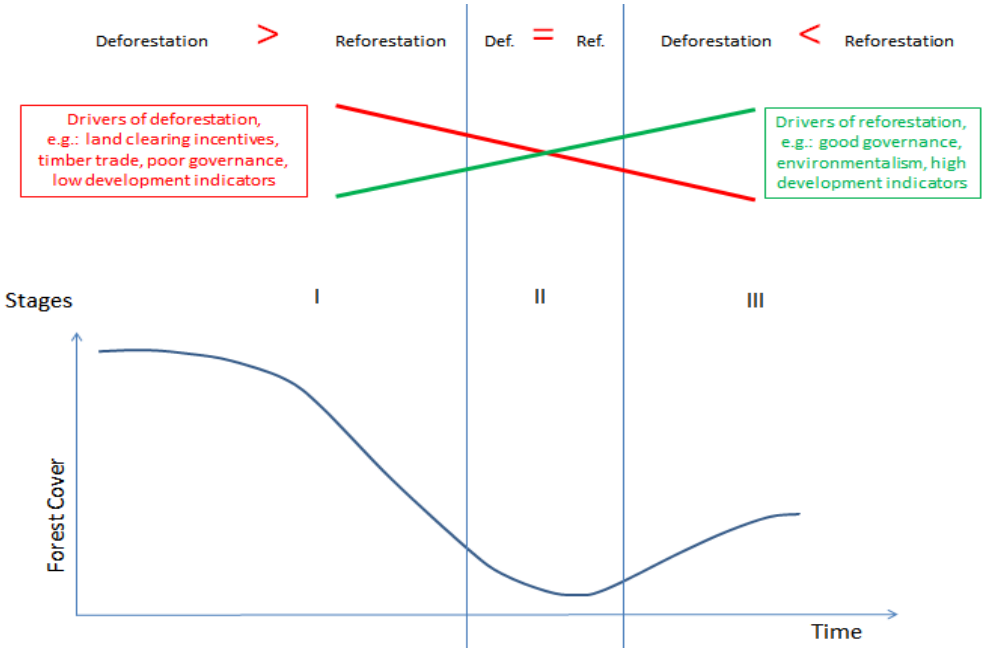

Figure2.Foresttransitionmodel with impactsontheforestcover.

2. Factors effecting forest transition

Forest transition is derived by many factors amongst them three factors are significant i.e. socio-economic transitions, institutionalactivitiesand the progress of environmental concerns (Li, 2013; Ordway, 2015; Redo et al. 2012; Reisch et al. 2013).

2.1 Socio-economic transitions

Economic changes are a wide array of drivers. Changes in the national and global economy tend to have a strong influence on land-use change in a particular country. A broadly understood modernizationprocess may lead to the development of adequate infrastructure. In the US the construction of railroads, and highways headed to a more effectiveinfiltration of the areas west of the Appalachians making the proximate and poor soils of New England uncompetitive with agricultural production from the Great Plains and the South. Consequently,the land become uninhibited and the large proportions of farm communities migrated to suitable agricultural lands or changed their livelihood moving to cities (Mather & Needle, 1997). Modernization also leads to the intensification of the agricultural sector: new ways of cultivating crops, growing mechanization or the use of chemical fertilizers bring higher productivity.

Closely tight is land specializationthat was originally proposed by Mather and Needle (1997) as the main driver of a forest transition. From one side the abandonment of low-quality land by agricultural practices occurs, while on the other side the more suitable land gets intensively utilized for agricultural purposes leading to a growing ‘specialization’ of land. As an example Mather presents his initial research area.

The data of the Black Isle in Scotland has been represented for more than hundred years. It can be found that more than 5 soils were uninhabited and later developed into forests. Simultaneously almost all the available class 1, 2 and 3 land is now used for agricultural practices (Mather, 1996). Such cases can be found on a greater scale e.g., agricultural lands in

the Northeast U.S. were abandoned and then developed into forestlands, on the other hand, the fertile forest lands on the south were exploited for agriculture.

2.2Institutionalactivities

Institutions play significant roles to make a forest transition successful, they are an important factor to halt the decline in deforestation. These institutions own efficient frameworks to deliver structures for evaluating the performances in regard to forest sectors and for successful forest transitions,further confirmed in various articles by experts in many countries.

World Bank Worldwide Governance Indicators use six phases of governance for evaluation. The phases are as follow:

1. Political stability measures the likelihood that the government can be destabilized or overthrown.
2. Regulatory quality focuses on the ability to formulate and implement decent policymaking.
3. Government effectiveness measures the quality of public and civil services.
4. Voice and accountability captures the perception to which extend citizens may participate in creating the government as well as assesses the freedom of speech.
5. Control of corruption measures the degree to which the government is capable of controlling corruption among its institutions.
6. Rule of law measures the quality of contract enforcement, property rights and the functioning of police and courts (Thomas, 2009; David et al. 2014; Mohamed, 2014; World Bank, 2014a).

2.3Progress of environmental concerns

The forest decline and the progress of environmental concernsoccur due to the raise of a civil society which lead to a forest transition, forest scarcity path describesgrowing public (and authorities') concern, increasing prices of timber and political pressure from within the country and abroad may lead to movements aiming at reversing the deforestation trend (Rudel et al. 2005; Barbier et al. 2010; Meyfroidt and Lambin, 2011).

3.Analysis of FT

During the early development phase, the main land-use trade-off pits agriculture and forestagainst each other. In response to economic incentives, land use choices are made at the microeconomicscale. When aggregated, they form a macroeconomic trend that can be viewed as the landuse/cover change (LUCC) of a given country or region. For several decades now, researchers havetaken an increasing interest in the LUCC in order to better predict the impact of local actionson global climate change (Lambin et al. 2003; Lambin and Meyfroidt, 2011). The FT hypothesis is a component of the LUCC framework since it allows a better understanding of the evolution of the forest area of a country and, as a result, the consequences in terms of climate or ecology. Following the FT hypothesis, the forest cover varies under different phases: deforestation, stagnation and reforestation (Wolfersberger et al. 2015).

The key phase of deforestation is comprised of two stages. First, roads are paved for the access of forests (Li et al. 2014). This facilitates agricultural boost by the development of new markets attracting local populations.The global rate of deforestation persistsshort, considered as the pre-development phase. Second, the increase of the native population involves a strong demand for food and space, it also ensures the supply of labor at low wages. The processing activities are also flourish i.e., dairies and slaughterhouses on the bases of the high population drift.Agricultural rents are relatively high and production expands. The clearing process is reinforced (Angelsen, 2007, 2010) and the deforestation rate is high. Increasing shortage of the environmental possessions validate the link of forest land into a public zone. Thecommon design of land property regimes isillustrated in Figure 3 (Bromley, 1991; Wolfersberger et al. 2015).

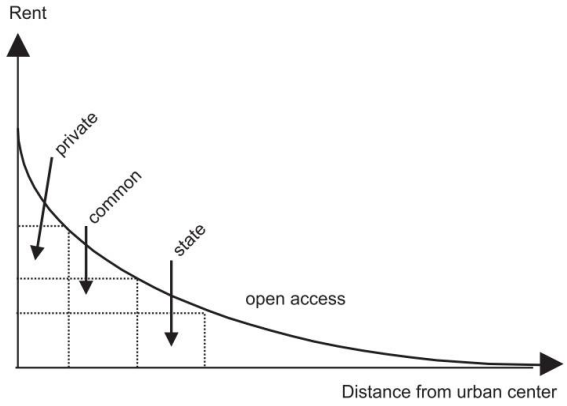

Figure 3: The rent gradient and property system.

The critical feature of the deforestation phase is the provision of income and capital providing adequate food and energy.Later a stagnation stage comes with the decline of agricultural rents and increase in forest rents marking the start of the deforestation. This corresponds to a reversal in the deforestation rate: the net variation of the forest cover sustainably turns from negative to positive or null. Grainger (1995) points out that the period of inactivityfor years or even for greater timespan, like in the case of England. Different paths based on empirical observations describe the occurrence of a turning point (Wolfersberger et al. 2015).

Referring to the statistics, a forest transition is certain: the worldmetwith several severe deforestationsin earlier few decades, with less than half of the forest remaining at the end of this period. Unless the steep rise in population and tripling of per capita GDP, the forest land is swiftly regenerating (Rodriguez, 2013). Due to the change in economy structure, socio-economic factor cannot be modified. The world has experienced a wide-range modernization transition in the last decade changing from a rural economy to urbanized form exporting unprocessed commodities of extensive farms (MIT, 2014).

4. Sustainable forest management

A promising development is the increasing number of countries aiming to direct policies targeted to encouraging sustainable forest management. In the past, the lack of international

consensus on the criteria and indicators defining SFMhas slowed global progress in implementing this goal (Weitz et al. 2014, 2015). However, in recent years, efforts by the International Tropical Timber Organization (ITTO), the European Union and the Montreal Process for temperate and boreal forests outside of Europe have evolved substantive international agreement on a clear set of guidelines for SFM(McDonald and Lane, 2004; McDermott et al. 2007). To date, progress is encouraging but mixed (Siry et al. 2005): More than 40% of the world's forest area has management plans, although it is unlikely that all of them fulfil the consensus criteria for sustainable forest management. Although 12% of theworld's forests are legislatively protected from harvest or exploitation, only 3% are certified by one of the major forest certification programs, and just 5% of the certified forests are in developing countries (Van Kooten et al. 2005; Cunningham et al. 2008). Progress is also being made in designing specific incentive schemes at the forest stand level to tackle some of the most pernicious timber production and mining practices, such as efficient fees and concession terms for timber harvesting and severance taxes onmining activities in forest areas (Ferraz and Serôa da Motta, 1998; Akpalu and Parks, 2007; Boscolo and Vincent, 2007; Cubbage et al. 2007).

However, past experiences in developed countries offer constructive lessons to developing countries about the fragility of policy statements that are committed to SFM but not accompanied by the introduction of the robust and resilient institutions needed for their implementation. In the USA, fifteen years elapsed between the passage of the Forest Reserves Act in 1890, which gave the President authority to designate public lands as National Forests, and the establishment in 1905 of a Forestry Bureau within the US Department of Agriculture that was strong enough to manage them effectively. Even then, the forest transition did not take place until about 1920 (Williams, 1989;Selman, 2001). There is also evidence that positive forest trends are more likely in countries with democratic political institutions (Mather and Needle, 1999a,b; Carr et al. 2005). These require not just the symbolic presence of a Westminster-style Parliament, or its US equivalent, but also the existence of political pluralism. This enables groups favoring forest conservation to have equal access to policymakers as those favoring forest exploitation (Grainger, 2004; Grainger and Malayang, 2006; Suich and Tacconi, 2012).

5. Conclusion

While looking at the forest transition drivers, it occurs that all drivers played their individual role. While land specialization was not a dominant factor, certainly it occurred on a more globalized scale resulting in low competitiveness. The most important factor was the structural economic changes such asthe globalizing world, growth of the touristic sector, and changing food. On the other hand, the growing popularity of exotic crops created a booming plantation sector, forming a strong incentive towards deforestation. The institutional transformation and environmental concerns also played an important role and can mostly be explained by the relatively stable governance and political system. Consequently, in terms of the FTis driven by structural changes in the economy and subsequently, the abandonment of agricultural land. However, simultaneously elements of the "forest scarcity path", including the political pressure for dealing with forest degradation are taking place globally. Growing issues must be addressed as well to improve our understanding of long-run land-use change in developing countries. Global environmental governance offers opportunities and incentives for private stakeholders to determine forest management that affects their livelihoods and profits directly. This review will highlight critical aspects to improve our knowledge about recognizing numerous factors affecting forest transition and derivers of sustainable forest management in future research.

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