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A Theoretical Argument on Deforestation

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Abstract: *In addition to being an environmental issue, deforestation affects a variety of socioeconomic and demographic groups. Deforestation sparks an expanding array of interdisciplinary research and studies in academic fields, whether at the global, regional, national, subnational, or site level. The purpose of this theoretical paper was to discuss theories of deforestation and how these theories fit in the deforestation agenda. Three theories were used in this discussion. These theories are: Environmental Kuznets Curve, theory of forest transition and Land rent. The Environmental Kuznets Curve theory suggests that deforestation initially increases with economic development but eventually declines as societies become more environmentally conscious. The forest transition theory posits that deforestation follows a U-shaped curve, increasing during early development and then decreasing as countries reach higher income levels. In summary, the land use that generates the highest land rent or value will be the one that drives competition among land uses, if profit maximisation is the driving force. By going over deforestation theories, we can determine that their common goal is to solve the environmental degradations—namely, greenhouse gas emissions and biodiversity loss—caused by deforestation in the forestry industry. Policy makers might concentrate more on certain strategic variables that are defined within proximal and underlying theories by identifying and categorising the direct and indirect elements that contribute to deforestation.*

Keywords: *Forest, Deforestation, Impact of deforestation, theories, Environment.*

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Introduction

The detrimental effects of declining forest cover have long been felt by civilization worldwide (Allen & Barnes, 1985). As of right now, the amount of forest cover worldwide is decreasing (Köthke et al., 2013). According to FAO (2010), the current yearly worldwide forest loss is estimated to be 13 million hectares, or almost 17% of the total annual emissions of greenhouse gases (IPCC, 2007). Future pressure on forests will come from growing worldwide demand for food, biofuels, and natural resources (Carlson et al., 2012).

Deforestation has been linked to a number of detrimental effects that raise worldwide expenses (Uusivuori et al., 2002). Microclimate change, fires, soil erosion, and damage of watersheds are all linked to deforestation. Deforestation may have detrimental effects on the world's biodiversity, hydrologic balance, global cycles of major elements, timber supply, and huge carbon emissions.

In addition to being an environmental issue, deforestation affects a variety of socioeconomic and demographic groups. It is currently on the international political agenda (Köthke et al., 2013). Deforestation sparks an expanding array of interdisciplinary research and studies in academic fields, whether at the global, regional, national, subnational, or site level (Damette & Delacote, 2012). Deforestation has become a multi-sectoral issue rather than just a problem affecting the forest industry. There is a broad range in the discussion and formulation of policy about deforestation. Therefore, this theoretical review paper seeks to overview some theoretical understanding of deforestation to assist us grasp its complexity and the environment in which a particular argument over deforestation is analysed. Understanding its theory is important for forecasting outcomes and future deforestation conditions, as well as for explaining current conditions (Rudel et al., 2005). Theories about deforestation, one of the main environmental challenges facing the world today, are relatively new, having emerged in the 1990s. Moreover,

the majority of deforestation occurs in tropical developing nations, where the complexity of culture makes it difficult to theoretically explain deforestation.

How to Define Deforestation

It appears that the phrases "forest" and "deforestation" are widely understood in daily life. Nonetheless, those terms need to be precisely defined and quantified for the benefit of science and policy. Despite being two of the most important global challenges, there is no universally accepted definition of forests and deforestation. With some updated data, the material in this section is primarily based on Schoene et al., (2007).

The Food and Agriculture Organisation (FAO) is a well-known organisation whose definition and data on the forestry sector are frequently used. According to FAO (2006), a forest is any area of land larger than 0.5 hectares that has trees that are at least 5 metres tall with a canopy cover of more than 10%, or that have the capacity to grow to these heights naturally. Land that is primarily used for purposes other than forests is not included in this definition. The Convention on Biological Diversity, also known as UNEP/CBD (2001), developed a different definition that keeps out temporary unstocked areas while taking into account the same minimum quantitative criteria (minimum 0.5 hectares, crown over 10 percent, and height of trees 5 metres). A somewhat different set of metrics is also developed by the United Nations Framework Convention on Climate Change, or UNFCCC (2006), utilising range values (minimum area 0.05-1.0 hectares, tree cover 10-30 percent, and tree height 2-5 metres).

Variables that influence deforestation

The majority of land life on Earth is found in forests, which make up approximately one-third of the planet's total area. Additionally, they are vital to human health because they clean the air and water and act as a first line of defence against newly emerging infectious diseases. Furthermore, forests sustain the livelihoods of billions of people by producing fuel and food, as well as more than 86 million green jobs. Because they function as carbon sinks, absorbing carbon dioxide that would otherwise be free in the atmosphere and causing continuous changes in climatic patterns, forests are also essential for reducing climate change.

However, the world's woods are in danger, endangering these advantages. Deforestation and forest degradation are two ways that the hazards appear. Agriculture is the main driver of deforestation, and inadequate infrastructure also plays a big role in the worldwide deforestation problem. According to the 2023 Forest Declaration Assessment, the globe lost more than 16 million acres of forest in 2022—an area larger than West Virginia. Road development, livestock grazing, and logging are the main drivers of forest degradation.

Because a large portion of the world's biodiversity is found in tropical rain forests, deforestation there is especially concerning. Approximately 17% of the Amazon's forest has disappeared in the past 50 years, mostly as a result of forest conversion for cattle grazing. In this area, deforestation is most prevalent along roads, rivers, and more populous places; nevertheless, the discovery of rich resources like as gold and oil has also led to the encroachment of forests into more isolated locations.

Views on Deforestation Theories

Research on deforestation is always expanding because it is a multi-sectoral problem. To explain how deforestation has happened, what variables are influencing it, and what policies might be proposed to solve this issue, empirical research have been investigated and reviewed. Intriguing theoretical research on deforestation has also been conducted; these studies have centred on the extent to which deforestation will occur and how its complexity may be explained. Knowing theory is important and vital to solving problems. We will talk about a few major hypotheses regarding deforestation in this part. The conversation will encompass each person's initial thought, fundamental concept or notion, and policy derivation, along with empirical investigations that make use of or are framed by those theories.

Theory of the Environmental Kuznets Curve

As discussed in the previous section, income and economic expansion are two of the many proximate and underlying variables of deforestation that have received significant attention. Environmental economists have developed the equilibrium knowledge curve (EKC) to examine the impact of income on environmental degradation. The EKC was originally adapted from the economics field proposed by Kuznets (1955), who established a correlation between income and equality. Grossman & Krueger (1991) look into the environmental effects of trade liberalisation (NAFTA) as a first step in analysing EKC application. Later, the EKC for deforestation was implemented in the forestry industry, based on the hypothesis that the concepts were similar. López (1994) explored the theoretical idea of the ECK for deforestation. When the internalisation of the stock effects of forest resource on agricultural productivity occurs, deforestation will decrease as economic or income growth increases. This idea holds that deforestation is a direct result of economic growth or prosperity. The pace of deforestation will accelerate until a specific turning point in the early stages of development, when GDP growth or level of affluence is relatively low. Deforestation is arguably one of the unfavourable effects of development at this early stage.

Numerous empirical investigations have been conducted at different levels since the theoretical conceptualization

of EKC for deforestation. There was only one research (Allen & Barnes, 1985) on the topic of deforestation and economic growth prior to the 1990s. But using FAO data from 1968 to 1978, their linear model method discovered a negligible correlation between GDP per capita and the overall change in forests. A number of well-known empirical studies have used EKC to measure deforestation; these include works by Antle and Heidebrink (1995), Bhattarai and Hammig (2001), Cropper and Grifiths (1994), Culas (2007), Munasinghe (1999), Panayotou (1993), Shafik (1994), and Stern et al. (1996).

However, there is inconsistent evidence regarding the existence of EKC for deforestation, ranging from no significant correlation (Antle & Heidebrink, 1995; Shafik, 1994; Uusivuori et al., 2002) to a significant existence for a particular region, namely Latin America and Africa (Bhattarai & Hammig, 2001; Cropper & Griffiths, 1994; Culas, 2007). Furthermore, in certain empirical investigations, researchers identify various shapes besides an inverted U-shaped curve, including an N-shaped curve (Bhattarai & Hammig, 2001) or a U-shaped curve for the Asia scenario (Bhattarai & Hammig, 2001; Culas, 2007). The development of the afforestation/reforestation programme could be one reason for the U-shaped curve (see Figure 3). EKC for deforestation continues to inspire numerous academics in the present day. Using FAO data from 1970 to 2006, a cross-country analysis by Ceddia et al. (2013) discovered the importance of the income influence on deforestation. According to Esmaeili & Nasrnia's (2014) time-series single-country study, the case of Iran exhibits an inverted U-shaped curve with a turning point of USD 24,555/capita. Mills Busa (2013) discusses a critical piece in which she argues that affluent countries should be held accountable for deforestation in less developed nations because of their imports. The curve, according to the author, can still be used to track how well developed nations' conservation programmes are doing. Last but not least, a fascinating finding from an empirical study indicated that deforestation occurred before severe industrialization (Panayotou, 1993). The fact that the tipping point for deforestation is comparatively considerably lower than that of other pollutants leads to this conclusion.

The relationship between development and the environment is central to EKC for deforestation. This idea states that during the development stage, there is a trade-off between the environment and the economy. In this context, the primary driving force behind the EKC study is the pursuit of the win-win solution (Munasinghe, 1999). It is imperative that developing nations learn from industrialised nations that have suffered environmental damage in their early stages of growth. These studies might motivate developing nations to restructure their development plans in order to take a more sustainable development path while maintaining their economic objectives. To sum up, the EKC "may assist developing nations in avoiding higher per capita income levels during critical junctures, consequently mitigating environmental degradation along the path to development" (Culas, 2007).

Theory of Forest Transition

Theorised as the forest transition theory, the dynamics of the forest cover is also recorded in the temporal dimension. Mather (1992) introduced this hypothesis. He first built this concept on the depletion-melioration model—a basic process of natural resource destruction and conservation—that was put forth by Friedrich and Whitaker in 1940. According to this concept, it is unavoidable to destroy natural resources in order to meet human requirements at an early stage. People will be encouraged to protect and restore their natural resources as a result of rising natural resource prices and demand. Foresters then use and expand on that concept in relation to deforestation. The theory of forest transition places greater emphasis on how the forest cover changes over time, either in terms of temporal changes or trends (Lambin & Meyfroidt, 2010). According to Mather (1992), the idea behind this theory is to look at "the transition point at the time of the lowest forest cover in a given region." Other straightforward ways to conceptualise this idea are as follows: the transition from deforestation to reforestation (Lambin & Meyfroidt, 2010; Mather & Needle, 1998), or the change in forest cover from diminishing to expanding forest areas (Mather, 1992). When a tendency of decreasing forest cover reverses and becomes an increasing trend, a transition occurs. The pattern seen in Figure 4's forest transition is further explained by Angelsen (2009). Following the phase of high forest cover and low deforestation rate when development is occurring, low deforestation rate and low forest cover result from lack of forest. Ultimately, by providing incentives for forest plantations or afforestation/reforestation, rising forest rent may hasten the changeover.

Barbier et al. (2010) show that there is a delay in the trend from decreasing to rising forest cover by looking at the pattern of forest transition from various nations and areas. Stated differently, there could be two stages to the transformation of a forest (Figure 5). These writers contend that the continued use of logged-over forest marginal land for farming, particularly in the case of agricultural subsistence, delays the process of reforestation. When planting trees on marginal property for commercial purposes, the market signal may take longer to arrive. Furthermore, a more intricate pattern that forest transition may display in several transition stages has been discovered by a recent study (Yeo & Huang, 2013). This study makes the case that policy has a significant impact on Mississippi's shift in forest cover. Within the framework of forest transition theory, researchers go deeper into the examination of not only the components involved but also the ways in which those elements shape the pattern of transition in order to explain the change in forest cover. The things that follow show different ways that a forest transition could happen.

i) The road of forest scarcity. According to this mechanism, fundamental variables from sectors other than forestry drive the forest transition theory. A scarcer forest will result in a higher price for forest products, such as recreational, environmental, and aesthetic values, when forest resources are removed to suit human requirements. The forestry industry will afforestation or replant in response to this commercial incentive. The tree-based land use intensification path is still included in this category. It occurs when a market incentive acts as a catalyst to encourage the planting of high-yield tree crops like fruit, agroforestry, gardens, and so on (Rudel et al., 2005).

ii) The route of economic progress. Following the extraction of forest resources for development, economic development typically results in the creation of off-farm opportunity jobs, which in turn draws rural residents away from their land-based economic pursuits (Rudel et al., 2005). Reforestation or the conversion of agricultural land to forestland usage will be prompted by the shortage of labour in rural areas. Improved agricultural technologies and agricultural intensification could also result from development. Due to this situation, agricultural activities will be restricted to the most advantageous location, perhaps freeing up additional land for reforestation. Higher prices for agricultural inputs and/or lower prices for agricultural product may lead to the concentration of agricultural operations on marginal land.

iii) State policy about forests. The government is a major factor in the change in land use cover. Since it owns the majority of the forests, the government has the political power and the means to either increase or decrease the amount of forest cover. A country's efforts to promote tourism and project a greener image may be linked to certain measures that support forest cover. Programmes for afforestation and reforestation in many nations ought to be recognised for the political will of the government as well. Yeo & Huang (2013) acknowledge that when the government plays a significant role in igniting the forest transformation, a new path—the forest management policy path—is recognised. Their concept and the state's forest policy direction appear to be comparable, nevertheless.

Path of globalisation (iv). Global market and economic integration (commodities, labour, capital, tourism, and ideas) is another process by which the forest cover changes over time. This approach identifies four primary processes: localised conservation ideas, labour out-migration, neo-liberal economic reforms, and increasing tourism. Rural communities can now export their forest products to international markets because to globalisation. More marginal land is left for forest conversion by impoverished individuals moving from rural to urban areas (Mather, 2007). On the other hand, the migration of affluent individuals from urban regions to rural ones increases the need for the aesthetic and environmental benefits that rural woods offer. International organisations can spread environmental ideas and activities over the world thanks to global integration.

The forest transition theory has been used in a number of recent studies to examine changes in forest cover or land use at various scales. Yeo & Huang (2013) investigate a long-term pattern of forest transition in Mississippi at the subnational level and discover the existence of a recurring cycle of forest transition in this region. Several national studies, such as those by Hostert et al. (2011) and Bae et al. (2012), have focused on this method. The previous study was carried out in the Soviet context, which is affected by two distinct disturbances: nuclear threat and political transition. The authors conclude that the effects of technological disruption (nuclear hazard) and socio-politic-economic disruptions (political change) are astronomically more substantial. The later study discovers that government policy can play a significant influence in transforming land cover towards a higher forest cover by analysing the case of the development of urban forest in South Korea, a country with rapid economic growth. A study conducted at the regional level in the Carpathian region (Eastern and Central Europe) by Munteanu et al. (2014) demonstrates how changes in institutional and sociodemographic parameters might influence the pattern of forest transition. Köthke et al. (2013) found a consistent pattern of forest decline and confirmed that there has been a worldwide forest shift by examining data from several countries between 1990 and 2010. For academic purposes, the forest transition approach can be used to describe how much deforestation and forest cover have changed over time, two significant issues. This theory's ability to be connected to other explanatory variables is another noteworthy aspect. As a result, this theory allows policy makers to deduce some alternative policies. measures to stop deforestation and measures to quicken the shift towards increasing forest cover are generally the two main policy directions that can be deduced (Lambin & Meyfroidt, 2010). As previously said, in the process, some implicit policies that are a part of every pathway can be used. However, in practice, the rivalry of values among various land uses will play a major role in how effectively forest cover is promoted (Barbier et al., 2010).

Theory of Land Rent

Von Thunen's 1826 land value framework is the foundation of the land rent approach to deforestation. This spatial economic theory of land use's central tenet is that a plot of land ought to be put to the use that has the greatest potential for revenue generation (Chomitz & Grey, 1996; von Amsberg, 1994). In this land use competition, distance or transportation costs play a significant role in terms of geography. In summary, the land use that generates the highest land rent or value will be the one that drives competition among land uses, provided that profit maximisation is the driving force.

Some scholars developed the theoretical explanation of this theory and adopted it for the forestry sector (Chomitz & Grey, 1996; Schneider, 1995; Walker, 2004). We should take note of a working paper by von Amsberg (1994), who has already taken the von Thunen model into account for his studies on forests. variations in the land rent of various uses are the key to understanding variations in land uses and land cover (Angelsen, 2007; Hyde et al., 1996). When compared to other potential land uses, forests can yield the most value, which is why they should be preserved. Conversely, if the land use intended for reforestation can compete with other land uses, then reforestation may be promoted on that particular piece of land. Land rent can generally relate to utility, profitability, or rentals (Walker, 2004). This value is observable from a dynamic angle. Land rents for either agricultural or forest use may fluctuate, to give an illustration of the competition between agricultural and forest land uses. Changes in labour pay, agricultural technology, agro-ecological conditions, agricultural production and input prices, and transportation costs can all have an impact on agricultural land rent fluctuations. However, changes in the cost of forest products, advancements in forest technology, or the introduction of financial incentives may affect the forest land rent (Angelsen, 2007). The most current topic of discussion in the climate change negotiations is the latter variable, the economic compensation mechanism in the forest sector, or REDD+ (reducing emissions from deforestation and forest degradation). According to this theory, financial incentives may be able to influence land rent and encourage beneficial changes in land use. REDD+ is a suggested economic mechanism to compensate landholders for conserving their forest or to encourage them to reforest their land in the context of reducing deforestation. In other words, it's the opportunity costs of passing up financial gains from other possible uses of the land in order to prevent deforestation (Ahrends et al., 2010).

A basic explanation for how land uses shift spatially is provided by the land rent theory (Angelsen, 2007). This idea enables researchers to explore the ways in which location shapes the landscape. Moreover, this theory allows for the examination of the degree to which the spatial structure of forest exploitation will be (Ahrends et al., 2010). The primary policy implication of this strategy for policy makers is to alter land rent composition in a way that makes it feasible to protect forest areas and/or encourage reforestation.

Many studies are now becoming interested in the land rent idea. Smallholders in the Amazon Basin consider distance (to the Trans-Amazon Highway) when allocating land, as demonstrated by a negative indicator of deforestation in the distance (Caldas et al., 2007). Similar findings about the relationship between forest loss and distance to the capital are obtained in the cases of Tanzania (Ahrends et al., 2010) and Indonesia (Busch et al., 2012). According to Robalino & Pfaff (2013), in Costa Rica, a payment for environmental service mechanism of this kind may be able to prevent deforestation by about 1% year. A similar process is that of Barua et al. (2012), who discovered that carbon payments, when paired with the taxation of cash-crop and forestry income, can work as a powerful deterrent against forest removal in Paraguay. REDD+ has currently been researched as an economic compensation, with studies conducted by (Busch et al., 2012; Gaveau et al., 2009) among others. The idea of land rent is applied not only in underdeveloped nations but also in affluent nations like South Korea where there is urbanisation and deforestation (Cho et al., 2014).

Conclusion

By going over deforestation theories, we can determine that their common goal is to solve the environmental degradations—namely, greenhouse gas emissions and biodiversity loss—caused by deforestation in the forestry industry. Policy makers might concentrate more on certain strategic variables that are defined within proximal and underlying theories by identifying and categorising the direct and indirect elements that contribute to deforestation. A fundamental understanding of the harm done to the environment throughout development processes is provided by EKC for deforestation. It looks at many options for policy to address the effects on the environment. The forest transition hypothesis centres on the temporal component, highlighting the need to shift the trend towards unexpected deforestation or forest loss towards a trend towards forest recovery or reforestation. A spatial economic perspective that explains how land usage for forests competes with other land uses is land rent for deforestation theory. These ideas present many fundamental concepts and perspectives about deforestation. They present various deforestation frameworks and methods. Nonetheless, the important message conveyed by all ideas is the same: we need to address the loss of forest cover.

While there are some similarities between the two theories, there are also considerable distinctions. First, the discourses of each theory are developed at varying degrees and in varying scopes. While land rent is clearly the aim of deforestation theory, forest transition is a temporal approach. Proximate and underlying theory may stimulate discussion on both macro and micro levels in the framework of the economic development stage, while EKC for deforestation may be properly placed on the macro level. Second, distinct schools of thought provided the basis for the development of each theory. The proximate and underlying approach and the forest transition theory are rooted in an ecological perspective, but the economics viewpoint is the foundation of the EKC for theories of deforestation and land rent.

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