

## ARTIFICIAL FORESTS, SAVING BIODIVERSITY. THE IMPORTANCE OF LIGNICULTURE

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### **Abstract**

*The importance of artificial (planted) forests in the world forestry economy has begun to be increasingly recognized, especially when trade price comparisons are made by economists and politicians. On the other side of the barricade are environmentalists, especially conservationists, whose ligniculture smells of plastic. However, as always, the truth is caught in the middle. Forests that grow from plantations, but not from seed-plus trees, are not the most durable and do not produce the most valuable wood, but they provide at least 80 percent of the beneficial ecological effects that a virgin or quasi-virgin forest body offers. Based on the estimated data for 2019, the application of the Global Forest Products Model (GFPM) shows that the existence of planted forests would have reduced the average price of firewood by 37%, roundwood by 24% and average prices for timber, panels, pulp and paper between 14% and 4%, depending on the degree of processing of these by-products. At the same time, the existence of planted forests led to an increase in global consumption, in 2019, by 1% for paper and cardboard, and by 14% for industrial roundwood, while reducing production in certain regions where the exploitation and development of the forest economy was strictly related to the wood material provided by the natural forests (virgin and quasi-virgin). Also, the gains in consumer welfare outweighed the losses of producers, with a net profit for general economic welfare of \$ 10,000 per hectare of forest.*

**Keywords:** *forests, wood, plantations, economy, wood industry, industries, models, GFPM*

### **INTRODUCTION**

Planted forests, made up of seedlings or by sowing, are playing an increasingly important role in the global forest economy, in resource conservation and in the fight against climate change. Globally, they occupy 258 million hectares or, in other words, 6% of the land area covered by forests (FAO, 2019). Their protection functions, carbon storage and conservation of natural forests are highly valued (Alliance Forêts Bois 2012, WWF 2012). In addition, planted forests are and will remain an essential source of wood (CARLE AND HOLMGREN, 2018).

This paper reflects the results of a study conducted to quantify the role of planted forests in the global forest economy. In 2019, the Global Forest Products Model (GFPM) was adapted for comparisons in the global forest sector, using the same benchmarks for natural forests, thus tracking the value of ecosystem services delivered by each category of forest.

The impact of planted forests on the price, quantity of products and ecosystem benefits consumed in various regions is significant. Everything is combined in an estimate of the effect of planted forests on economic well-being and, in particular, on the perspective of reducing the pressure on natural forests, which preserve biodiversity.

**METHODS**

The analysis implies a competitive global market for wood and its by-products. Planted forests increase the supply of wood and products derived from them. The result is lower prices and higher consumption. In a globalized and increasingly voracious market, lower prices can lead to lower production costs for wood products and in areas without or with little planted forest, as well as increased trade in deficient regions. These effects are quantified with GFPM, the current version of which is described by BUONGIORNO AND ZHU (2017). The model represents demand, supply and trade with 14 groups of wood-based products in 180 countries. This model also calculates the balance of the market and simulates its evolution. Here, the model reproduces the global forest sector from 2019 and what this sector without planted forests would have looked like.

Previously, the balance was calculated by maximizing, under constraints, the surplus of consumers and producers (the value of consumer products minus production and transport costs) - SAMUELSON (1952). The constraints are that for each country and product, supply (import, plus domestic production) is equal to demand (domestic consumption, plus exports). The application of the model makes it possible to obtain the quantities consumed, produced and traded, after which the prices by countries and products are deducted.

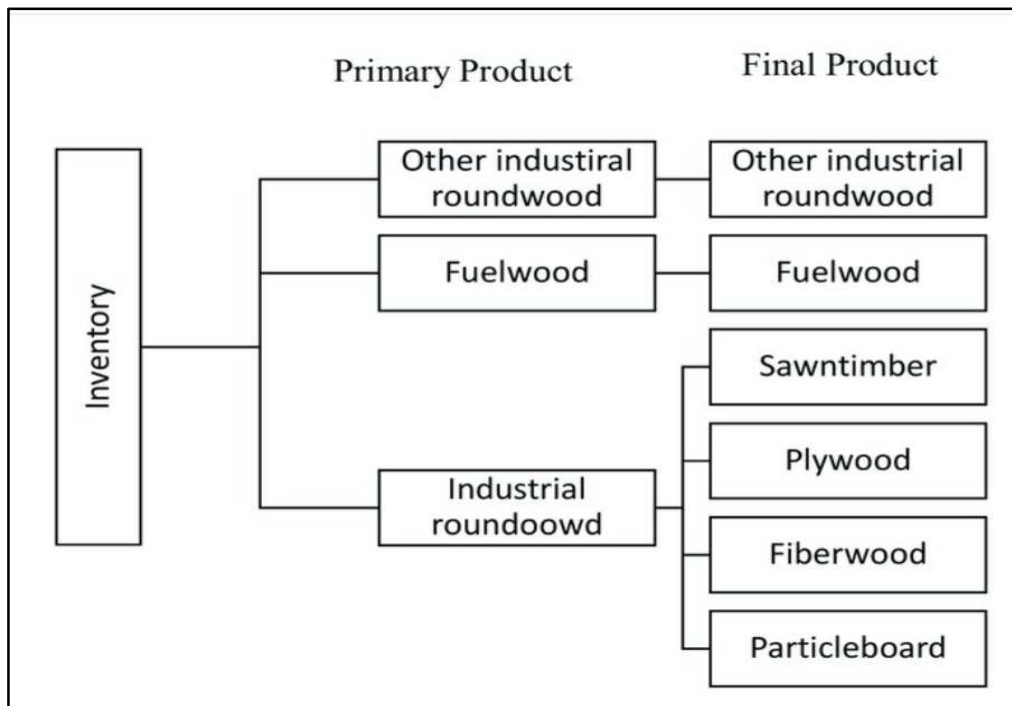


Figure 1. Forest products in GFPM. Global model of forest products: structure, estimation and applications. Adapted from Buongiorno, J., Zhu, S., Zhang, D., Turner, J. and Tomberlin, D. (2017).

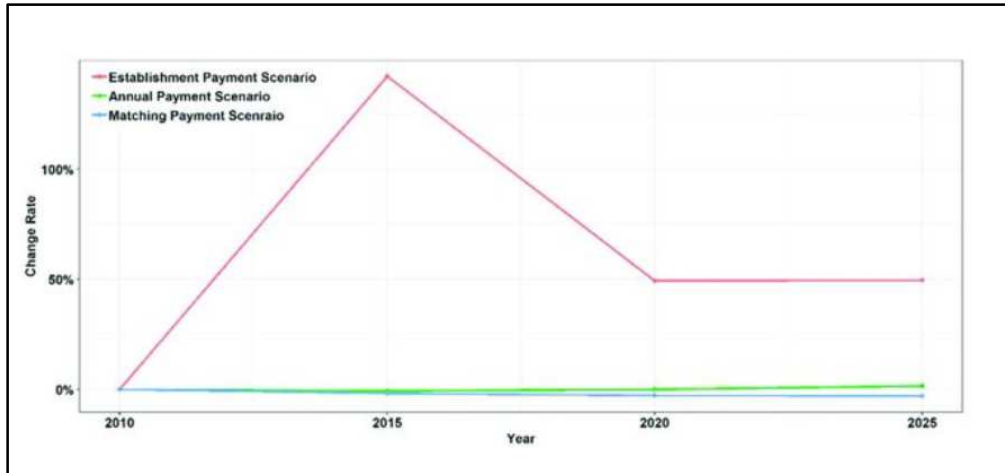


Figure 2. Changing the production of industrial round wood

Data on production, imports, exports and prices come from the FAOSTAT basis (FAO, 2019). Data on supply and demand elasticity and other GFPM parameters are those used in the latest prospective study by the US Forest Service (Buongiorno et al., 2012). The solution provided by GFPM reproduces the observations for 2019.

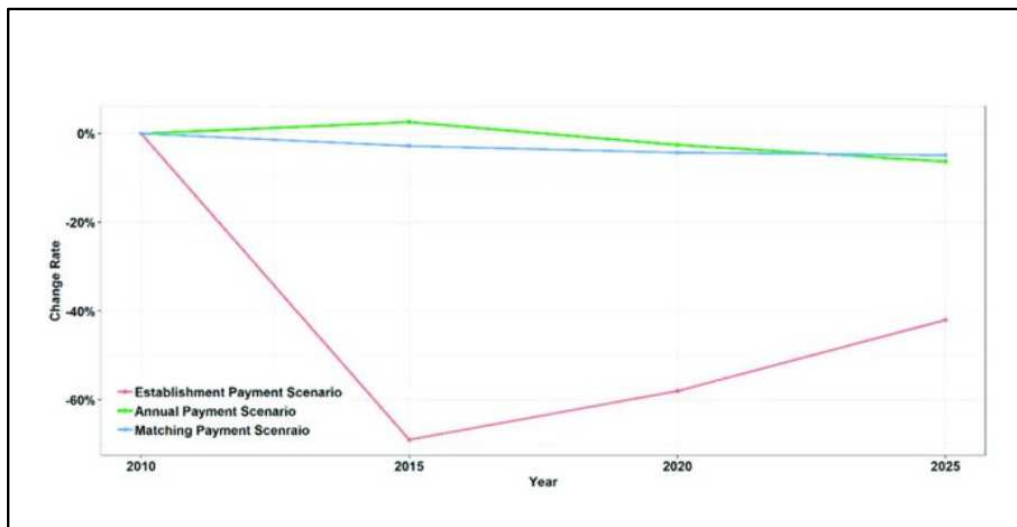


Figure 3. Changing the price of industrial round wood

This situation is represented by an increase in timber production at a given price, due to timber production from forests that have emerged as a result of the application of ligniculture. The productivity of planted forests is generally much higher than that of natural forests (PRAKASH, BUONGIORNO, CRAIG, 2019). The assumption is that the fraction of production in planted forests exceeds the fraction of the area occupied by a Lorenz curve (GARWIRTH,

1972). The curve adopted satisfies the observations for the Landes de Gascogne, which occupies 6% of French forest territory, produce 23% of the harvest and those for the southern United States where planted forests produce 43% of national production, on 22% of the forest area.

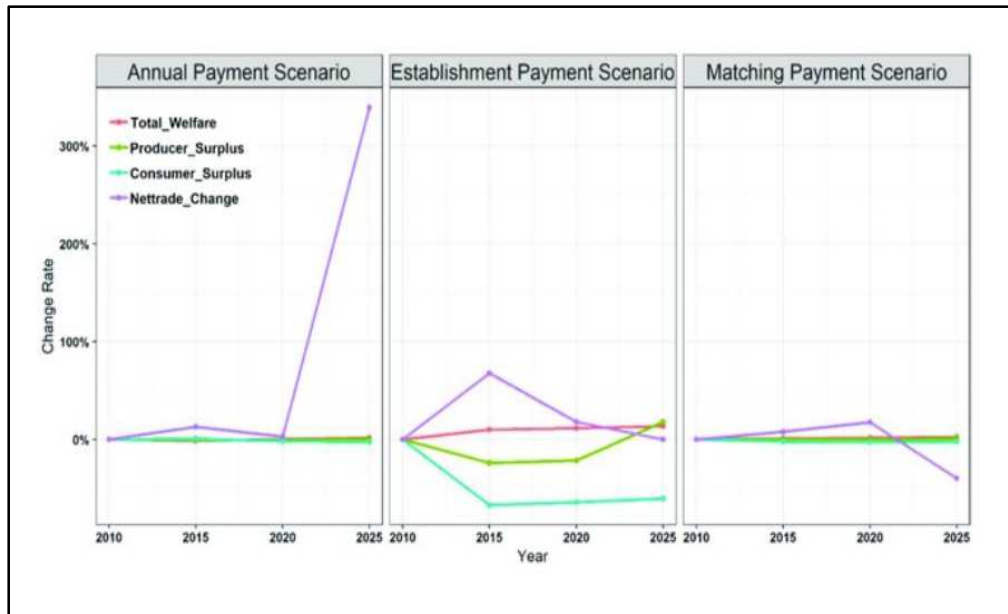


Figure 4. Welfare change in three scenarios

## EFFECTS OF PLANTED FORESTS

### Effects on prices

In a competitive global market, prices are the most important indicator of the effect on resources and policies on supply, demand and trade. The effect of planted forests is to reduce the price of heating by almost 40% and increase the production of industrial roundwood by almost 25%. The impact on the price of paper and cardboard is much lower because the price of wood contributes a very small share to the formation of the price of these products.

### Effects on consumption and production

Planted forests increase global consumption and production by 4% for heating, 14% for industrial roundwood and 2.5% for timber and panels. Consumption of pulp (8%) increases more than that of paper and cardboard (1%) due to the replacement of waste paper with wood pulp, as well as due to the reduction of pulp prices, induced by the decrease in the price of wood in planted forests. In some areas, production is lower than in planted forests, where the negative effect of price reductions on the supply of the finished product exceeds the positive effect, which is caused by the lower price of timber from planted forests.

### **The effects of planted forests on general economic well-being**

General economic well-being is defined here in a limited way as the sum of the surplus of consumers and producers. Excess consumption is the difference between what consumers would pay and what they actually pay. The surplus of the producers is their profit, the difference between what they collect and the production costs. The presence of planted forests has increased the consumption of firewood, lumber, panels, paper and cardboard in 2019 to \$ 108 billion globally (of which \$ 43 billion in Asia and \$ 21 billion in Africa). On the other hand, the overall decrease in the surplus of timber producers in natural and planted forests is \$ 31 billion (of which 1 billion in Europe), a result obtained by compensating for the loss of natural forests with the surplus obtained by producers in planted forests.

Overall, the decrease in the producer surplus is only one third of the increase in the consumption surplus. The result is a global increase in welfare by 77 billion dollars, about a third of Romania's GDP. The main effect is in Asia, followed by Europe and Africa. The average increase in economic welfare per hectare of planted forest was, in 2019, \$ 300 per year. At an annual interest rate of 3%, the present value of this amount at an infinite horizon is \$ 10,000 / ha, reaching as much as \$ 29,000 / ha in Africa.

### **The effects of planted forests on natural forests**

Artificially developed forests, from plantations, reduce the harvest in natural forests, with obvious ecological benefits for ecosystem conservation, biodiversity conservation and carbon sequestration.

According to GFPM estimates, planted forests would reduce the global harvest of natural forests in 2019 by about 26% and 816 million cubic meters, respectively, less than the share of planted forests in global production (32%). The difference would be due to the decrease in the price of wood induced by planted forests, which would lead to an increase in demand and, therefore, to an increase in harvesting from planted and natural forests. As a result, there is a "leakage" of about 6% by replacing the harvest in natural forests with that in planted forests.

## **CONCLUSIONS**

Planted forests significantly reduce the overall price of timber and timber products, in proportion to the share of timber in the cost of production. The decrease in price increases consumption for almost all products and in all regions. On the other hand, the presence of planted forests in the timber industry, globally, may lead to a reduction in production in 2020, and further, in some regions, depending on the importance of planted forests and the comparative advantages of countries.

As a result of the reduction in prices, the profits of producers in natural forests decrease more than the profits of producers in planted forests. However, the gains in terms of the economic well-being of consumers of timber products far outweigh the losses of producers, resulting in a net gain in terms of economic development, in general, in the forestry sector. On the other hand, despite the boom due to the increase in the consumption of planted wood and, implicitly, in the revenues, it remains to be seen what the long-term benefits will be. This is because wood consumption is induced by lower prices, and planted forests significantly reduce the volume of harvesting in natural forests. The ecological results remain to be evaluated in another research.

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