

## **Economic analysis of carbon sequestration at stand level**

**Pohjola, Johanna<sup>1)</sup> and Valsta, Lauri<sup>2)</sup>**

1) Finnish Forest Research Institute

2) University of Helsinki, Department of Economics

### **ABSTRACT**

Forests can be used to mitigate climate change by increasing the amount of carbon in forests. We use a joint production model of timber production and carbon sequestration to analyse the financially optimum silvicultural strategies for Scots pine and Norway spruce at the stand level in Finland. Economic incentives to increase the amount of carbon sequestered are provided with a carbon subsidy/tax programme. The earlier analyses is expanded by taking into account thinnings as measures to increase carbon stocks in forests, in addition to lengthening the rotation age. Rotation as well as thinning timing and intensity are simultaneously optimized. The analysis is based on individual-tree growth models and a derivative-free, non-linear programming algorithm.

The results indicate that, in joint production, both the growing stock level and rotation length are increased, compared to pure timber management. The results show clearly the importance of thinnings when increasing carbon sequestration. For Scots pine stands, a major share of the increase in average carbon storage during the rotation period was obtained by modifying thinnings while lengthening the rotation age had a minor impact, with carbon prices of 10 and 20 €/t CO<sub>2</sub>. On the other hand, delaying the clearcutting provided most of the increase in average carbon storage in the case of Norway spruce. Discounted net revenues to the forest owners were considerably increased by the carbon tax/subsidy programme. Discounted income from carbon sequestration consisted of about a half of the joint net present value of income for both Scots pine and Norway spruce, with carbon sequestration credits of 10 €/t CO<sub>2</sub>, when starting from bare land. However, for mature stands the net revenue from carbon sequestration was negative due to the near-term tax on carbon release. The carbon tax/subsidy programme increased the average timber yield in a fully regulated forest framework due to the considerable increase in the yield of sawlog, whereas the yield of pulpwood was somewhat decreased.