

# Financial effects of silvicultural measures in pure spruce protection forests in the Bavarian Alps

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The natural vegetation in the montane zone of the Bavarian Alps consists of mixed stands of spruce (*picea abies*), beech (*fagus sylvatica*), fir (*abies alba*) and maple (*acer pseudoplatanus*). However, large areas are now covered by pure spruce stands which require stabilizing silvicultural treatments. Research has shown that the stability of these stands can only be increased if silvicultural measures are applied at a very early stage. But these measures often generate a financial deficit. Hence, in practice, managers often omit these treatments. But this undermines protection functions of the stands.

We evaluated the financial impact of silvicultural methods. Risks caused by snow breakage, wind breakage and insects were taken into account via survival probabilities. Two scenarios have been compared. We included six harvesting methods with differing costs in the financial calculations. While in untreated plots only stand establishment and harvesting of trees at the age of 100 has been assumed, in treated plots also thinning measures at the age of 40, 60 and 80 have been assumed. We calculated net present values. Contingency risks were incorporated in Monte-Carlo simulations. The final assessment has been carried out according to two methods of investment appraisal ( $\mu-\sigma$  Rule and Stochastic Dominance).

Both methods lead in most cases to the conclusion that treated stands generate a higher financial benefit than untreated stands when risks are taken into consideration.

The case study shows that the decision-making process based on financial aspects without considering risks can be misleading. But taking the risks into account, often measures that are desirable from a silvicultural point of view can also be justified financially.

**Keywords:** silviculture, montane zone, risk, Monte-Carlo Simulation,  $\mu-\sigma$  Rule, Stochastic Dominance, survival probability.

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