

Adaptation and Mitigation to Climate Change by the Multipurpose Modelling of Forest Management Planning

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The present study examines the application of simulation and optimization tools to the state of the art planning of multipurpose forest management adapted and mitigated to climate change. The prediction of the evolution of forest stands in different ages and affected by silvicultural interventions were simulated by a modern forest growth model "TreeGrOSS". This simulator is adjusted for Norway spruce (*Picea abies* Karst) and encompasses a juvenile module for European Beech (*Fagus Sylvatica* L.) which is suitable for the analysis of alternative scenarios. Scenarios were defined basically according to the approach of Hanewinkel (1996) for the conversion management of pure Norway spruce towards mixed spruce-beech forests. Post-Simulation planning of a forest enterprise was conducted with the authoritative multi-criteria optimization tool "RiskOptimizer" which is able to solve stochastic complex large-scale problems. The applied approach of the simulation and optimization made it possible to deal with the interactions of conflicting goals of multipurpose forestry to come up with the actual problem of global climate change. Carbon sequestration by means of biomass conservation as an adaptation strategy to climate change and biodiversity enhancement with native species as mitigation strategy both were evaluated by Faustmann formulae. The benefit-cost calculations were transferred to the whole region of Baden Württemberg in southwestern Germany to provide as a guide for the forest decision-makers. Effects of finite and infinite decision alternatives (small /large -scale decision space), linear and non-linear objectives/constraints, spatial unit of observations (stand or forest enterprise), and risk analysis of economic uncertainties (i.e. interest rate, regeneration cost and wood prices) were analysed in four consecutive steps of the study. Finally, a balanced solution was found which introduces a combination of different silvicultural interventions for adapting to/ mitigation of climate change with the partial conversion of Norway spruce towards beech-spruce forest.

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