Investment decisions under uncertainty -
A methodological review on forest science studies

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Several parametric and non-parametric approaches have been developed to value financial assets. Yet, financial valuation techniques have only slowly percolated into disciplines concerned with the management of ecosystems. Particularly in forest management, decision-makers find themselves often confronted with extremely long time horizons and severely uncertain information. This requires careful valuation approaches, which are often underrepresented or even completely lacking in forest management. This paper gives a comprehensive overview on techniques for financial decision-making under uncertainty and develops future research needs.

First, we analyzed the approaches of expected utility, option pricing, stochastic dominance, downside risk and robustness as possible opportunities to draw decisions on forest investments and gave a short review about forestry related applications. Afterwards we discussed the suitability of the presented approaches to support decisions in forestry and concluded that robust optimization techniques have to be developed further, especially since erroneous financial data is likely to occur as well as deviations from the assumption of normality. For the time being the maximization of the financial robustness was probably the most adequate approach for many long-term decisions in forestry, such as selecting the optimum tree species composition. Further development of this approach seems possible and necessary.
Finally, we come to the conclusion that even though it is intuitively clear that many long-term decisions should consider uncertainty, adequate financial valuation is not developed enough in forest science. In the case of Central Europe, this might be an effect of the dominance of ecological research in forest science. Consequently, an intensification of the analysis of uncertainty in forest decision-making is necessary.

***Key words*:** Uncertainty, diversification, mean-variance, option pricing, stochastic dominance, downside risk, lower partial moment, information-gap decision theory, robustness

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