Economic value of forest genetic diversity in the face of climate change

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Due to the long tree-rotation in forestry, adaptation to climate change can not be done between rotations but needs to be done within a rotation. This is a challenge for forestry and point at the importance of the genetic material.

Forest genetic research has traditionally been aimed at improving the use value of forests related to wood production, including breeding and provenance trials with selection for general adaptation across a range of environmental conditions. Often, when production is the aim forest owners select a single or a few provenances recommended for specific localities based on results from tree improvement programmes. However, climate change may alter the environmental conditions in a specific site within the time span of a rotation thereby rendering an unforeseen change in optimal provenance.

The value of diversification is well known in economics, e.g. the value of risk reduction through diversification in a portfolio of assets on the stock market. However, the economic value of genetic diversity in forests goes beyond the risk reducing effects and includes e.g. option values when several clones or species are mixed in the same forest stand. Applying data from clonal trials with Norway spruce in Denmark and Sweden trial this paper aims at exploring the economic value of having several different clones either as separate stands or mixed in the same forest stand; this in order to hedge against the uncertain changes in environmental conditions induced by climate change.

Based on the knowledge of differences of growth between clones on different locations, we use a dynamic growth model to model growth with stochastic changes of growth conditions. By the use of simulation and dynamic optimisation we are able to show that diversity within stands not only lowers variation in case of climate change, but if planted in the same stand also increases the expected value. This is due to the possibility of removing trees that on the way proves less successful to the observed change and let the growing space be taken over by others. Furthermore, we see that if we apply forward looking adaptive management, we may increase the expected value further as we keep trees in the stand which may perform better if climate changes.

Even though we are looking at what may be perceived as a genetically quite narrow material (clones from only one specific species), we are able to demonstrate the potentially large gains from securing a reasonable level of genetic diversity. This is of importance both for the forest owners, but also for society as forests produce many other products than wood, e.g. recreation, biodiversity, etc. which is at risk of disappearing or be lowered if climate change causes severe damage to existing forests. Thus it may not only be a single-stand problem, but rather a regional problem.

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