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Modelling Austrian forest seedling demand under different adaptation management strategies

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Forest plantations provide various ecosystem services. Forest seedling production in nurseries in particular plays an important role in ecosystem service management to support sustainable forest management and facilitate adaption to and mitigate the effects of climate change in the forest-based sector. Climate change will considerably affect environmental conditions that heavily affect tree species in alpine regions, such as temperature and precipitation patterns and thereby generating risks for forests and thus timber supply for the sector. To address these risks for ecosystem services, planting of different tree species and provenances better adapted to the expected future environmental condition must be considered.

Historical data on mast seeding and seed harvest from 1960 to 2016 were collected and analysed for seven native tree species. In order to estimate the demand for forest plantations of key tree species, the most important climatic factors affecting variable seed production were investigated for four forest adaptation strategies (1) a business-as-usual scenario, (2) natural regeneration, (3) assisted migration, and (4) assisted gene flow. The goal was to determine the effects of these strategies of the seven studied tree species as well as the loss or gain of forest area for each single species. In addition, an econometric model including relevant forestry data (logging activity, deadwood, lumber prices of wood assortments) as well as data on economic development and forest nurseries was formulated to explain historical seedling demand and estimate the future demand for forest seedlings in Austria.

Present and future distribution ranges were estimated on basis of species distribution models from previous projects for the native tree species as well as for the non-native Douglas fir. Our approach aims to determine the annual regeneration requirement and seedling demand considering the average age-class distribution of Austrian forests under changing climatic conditions within the country.

In combination with the econometric model, predictions for future seed yield can be made and new suitable plantation areas for each species determined. Since producers of tree seedlings currently face a high degree of uncertainty owing to the 1-year to 4-year lag between the beginning of the production process and marketing of the seedlings, our results will help to minimize production risks and provide a sufficient supply to cover future market demand for seedlings. The results will also help to develop transnational climate change adaptation strategies to ensure future forest ecosystem services in Austria and Central Europe.