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Optimizing rotation management of forest plantations: the effects of carbon accounting methods

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Forest has great value both in storing carbon and timber production. Afforestation has been widely undertaken across countries to achieve their goals in poverty alleviation and environment protection, specifically in mitigating the atmosphere carbon concentration. This study determines the optimal rotations of different forest types in China's afforestation projects considering the costs of benefit of afforestation and the carbon value under two different carbon accounting rules, tCER and ICER accounting. The optimal rotation periods of three tree species, Eucalyptus, Chinese fir and Poplar, were estimated using data from various Chinese regions. We apply a modified Hartman rotation model to calculate the optimal rotation period. Results show that at carbon price of 15 USD per t CO₂ for a 5-year validation period, the optimal rotation period are all extended with the highest increase (5 years or 29%) found for Chinese fir (E, N, NE) under tCER accounting after considering the value of carbon sequestration. However, the optimal decision for Eucalyptus is extended to 3 years or 60% under ICER accounting. Poplar plantation is less influenced by either tCER or ICER accounting. We further examine the sensitivity of the optimal decision to carbon price and interest rate. Results show the optimal decision of Chinese fir is highly sensitive to the changes of carbon price or interest rate under tCER accounting, while that of Eucalyptus is the most sensitive under ICER accounting. We demonstrate the significant effects of carbon accounting methods and plantation species on the determination of optimal rotation period for afforestation projects. The findings can contribute to the sustainable management of carbon sequestration projects. The methodology can also be applied to other regions in the developing world.