

Effects of Different Thinning Intensities on Carbon Storage in *Pinus koraiensis* Middle-Aged Plantations in Northeast China

Nazmus Sakib^{1,2}, Tika Ram Poudel³, Yuanqin Hao^{1,2}, Nathan James Roberts³, Abdu I-Qadir Iddrisu^{1,2}, Saraswoti Adhikari¹ and Peng Zhang^{1,2,4,*}

¹College of Forestry, Northeast Forestry University, Harbin 150040, China;

²Key Laboratory of Sustainable Forest Ecosystem Management-Ministry of Education, Northeast Forestry University, Harbin 150040, China

³Feline Research Center of National Forestry and Grassland Administration, College of Wildlife and Protected Area, Northeast Forestry University, Harbin 150040, China;

⁴State Forestry and Grassland Administration Engineering Technology Research Center of Korean Pine, Harbin 150040, China

*Correspondence: zhangpeng@nefu.edu.cn

Abstract: Forest ecosystems are essential to the global carbon cycle because they are the biggest terrestrial carbon reserves. In the management of forests, thinning is a commonly employed strategy, impacting the respiration and biomass loss of trees, thereby modifying forest carbon dynamics. However, there is a lack of scientific research to confirm the impacts of thinning intensities on carbon storage in trees, soil layers, shrubs, and ground vegetation layers as well as its impact on wood production and growth rate. The goal of this study was to find the optimal thinning levels for increasing carbon sequestration during the growth stage of the Korean pine (*Pinus koraiensis*) middle-aged plantations in Northeast China. In this study, thinning intensity (0, 10, 11, 16, 18, and 22%) affected the carbon storage of trees, tree growth, volume, and, we suspected, soil layer, shrubs, and vegetation (herbs, litter, and grass) also. Specifically, after four years of thinning, the 18% treatment significantly increased total carbon storage, individual organ storage, growth, and tree volume ($p < 0.05$). These results give us abundant information about how thinning affects the dynamics of carbon storage, wood production, and the interactions between soil and plants in *P. koraiensis* plantations, contributing to multi-objective management strategies for optimizing carbon sequestration, wood production, and ecosystem health.

Keywords: forest thinning; carbon storage; soil carbon; tree growth; wood volume