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Maintaining an Optimal Flow of Forest Products under a Carbon Market: Approximating a Pareto Set of Optimal Silvicultural Regimes for Eucalyptus fastigata

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ABSTRACT

A competitive co-evolutionary Multi-Objective Genetic Algorithm (cc-MOGA) was used to approximate a Pareto front of efficient silvicultural regimes for Eucalyptus fastigata. The three objectives to be maximised included, sawlog, pulpwood and carbon sequestration payment. Three carbon price scenarios (3CPS), i.e. NZ $25, NZ $50 and NZ $100 for a tonne of CO_2 sequestered, were used to assess the impact on silvicultural regimes, against a fourth non-carbon Pareto set of efficient regimes (nonCPS), determined from a cc-MOGA with two objectives, i.e. competing sawlog and pulpwood productions. Carbon prices included in stand valuation were found to influence the silvicultural regimes by increasing the rotation length and lowering the final crop number before clearfell. However, there were no significant changes in the frequency, timing, and intensity of thinning operations amongst all the four Pareto sets of solutions. However, the 3CPS were not significantly different from each other, which meant that these silvicultural regimes were insensitive to the price of carbon. This was because maximising carbon sequestration was directly related to the biological growth rate. As such an optimal mix of frequency, intensity, and timing of thinning maintained maximum growth rate for as long as possible for any one rotation.

KEYWORDS

Optimal Control; Competitive Co-Evolutionary Multi-Objective Genetic Algorithm (cc-MOGA); Pareto Front; Forest Holding Value; Kruskal-Wallis Test; Multiple Comparison Procedure

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