Optimal Forest Management for

Carbon Sequestration and Biodiversity Maintenance

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ABSTRACT

Managing planted forests for carbon sequestration and biodiversity maintenance has become increasingly important in times of rapid climate change and the loss of biodiversity worldwide. The objectives of this study are to find out private and socially optimal management strategies for planted forests, and suggest an appropriate policy for promoting multiple-use forests.

The research attempts: (1) to identify the harvesting strategies of forest stands that can maximise the benefits from timber production and carbon sequestration; (2) to identify the patterns that can balance economic gain and biodiversity maintenance; (3) to examine the actual management strategies and biodiversity conservation attitudes of forest owners; and (4) to recommend policy tools that can be used to align private with socially optimal decisions.

The Faustmann model is extended to include carbon sequestration, biodiversity conservation, multiple forest stands and spatial arrangements among forest stands. The Safe Minimum Standard Approach is employed to model biodiversity conservation. The number of birds is used as a biodiversity indicator. A direct search algorithm is used to determine optimal sets of harvesting strategies. The models are applied to planted forests in Yen Bai province, Vietnam. To get primary data, 291 household forest owners and 4 state enterprises, growing *Eucalyptus urophylla* and *Acacia mangium* were surveyed.

The results show that the actual cutting ages are 5 and 7 years for household and enterprise forests, respectively. Both the optimal timber and carbon rotation ages are between 9 and 11 years for two species. The value of carbon uptake makes the optimal rotation age slightly shorter. The incorporation of spatial arrangements has little impact on the optimal rotation age, but significantly increases the net present value. The inclusion of biodiversity conservation lengthens the rotation age and significantly reduces the profitability of forest owners. Policy implications are that payment for carbon sequestration services of planted forests in Vietnam is feasible. Merging small forest stands of several forest households should be encouraged. Direct payments are an appropriate policy tool to encourage household forest owners to lengthen rotation ages in order to enhance biodiversity.

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LIST OF RESEARCH OUTPUTS DURING THE PHD STUDY PERIOD

EEPSEA 31st Biannual Workshop. Presenting final research report titled *Optimal Forest Management for Carbon Sequestration: A Case Study of Household Forest Owner and State Enterprises,* 16-19th November 2009, Hanoi, Vietnam.

The 17th EAERE Annual Conference. Presenting the paper titled *The opportunity cost of biodiversity in planted forests: A Case Study of Pinus Radiata in New Zealand,* 24-27th June, 2009, Amsterdam, the Netherlands.

International Scientific Congress "Climate change: Global risks, Challenges and Decisions". Presenting the paper titled *Optimal Forest Management for Carbon Sequestration: A Case Study in Yen Bai Province, Vietnam,* 10-12th March 2009, Copenhagen, Denmark.

EEPSEA 29th Biannual Workshop. Presenting research proposal titled *Optimal Forest Management for Carbon Sequestration: A Case Study of Eucalyptus Urophylla and Acacia Mangium in Yen Bai Province, Vietnam,* 5-8th May 2008, Nonthaburi, Thailand.

Environmental and Resource Economics Early-Career Researcher Workshop. Presenting the paper entitled *Optimal Forest Management for Balancing Economic Gain and Biodiversity over Multiple Age-classes and Spatial Interdependence*, 12-13th November 2007, Charles Sturt University, Australia.

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LIST OF ABBREVIATIONS AND SYMBOLS

CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
CV	Contingent Valuation
EUR	Euro
FAO	Food and Agriculture Organization
GAMS	General Algebraic Modelling System
FAO	Food and Agriculture Organization
ha	Hectare
MARD	Ministry of Agriculture and Rural Development
MVP	Minimum Viable Population
NPV	Net Present Value
PES	Payment for Environmental Services
r	Discount Rate
SMS	Safe Minimum Standard
T	Optimal Rotation Age
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
VND	Vietnam Dong