

International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

May 23-25, 2022, Traverse City, Michigan

Abstracts



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Abstract Title and Authors

Economic drivers of regional forest protection and restoration carbon leakage	5
<i>Adam Daigneault, Brent Sohngen</i>	<i>5</i>
Preferences and Willingness to Enroll in Woodland Conservation Program in Ohio USA.....	6
<i>Ahmed Saad Hussain, Sayeed Mehmood</i>	<i>6</i>
The effect of information nudges on landowner's willingness to meet with public foresters	7
<i>Ana Gutierrez, Jerrod Penn, Michael Blazier.....</i>	<i>7</i>
Managing longleaf pine forests for timber production and carbon sequestration: an optimal control analysis	8
<i>Andres Susaeta</i>	<i>8</i>
The Economic Value of Prescribed Burning in Northeastern Forests.....	9
<i>Arun Regmi.....</i>	<i>9</i>
A Least Cost Dynamic Optimization Approach for Obtaining a Desired Balanced Uneven-aged Structure	10
<i>Basanta Lamsal, John Wagner.....</i>	<i>10</i>
Willingness to Pay for Deer Hunting Site Attributes using Best-Worst Choice	11
<i>Bijesh Mishra, Rodney Will, Omkar Joshi.....</i>	<i>11</i>
A Regional Predictive Model for Maple Syrup Production in United States	12
<i>Bobby Thapa, Thomas O. Ochuodho,</i>	<i>12</i>
The impact of carbon-offset programs on the timber supply chain in the US South	13
<i>Bruno Kanieski da Silva, Jesse Henderson, Shaun Tanger, Rajan Parajuli, Frederick W. Cabbage.....</i>	<i>13</i>
Exploring the relationship between forest management and forest carbon storage and sequestration: lessons and applications from FIA data and a hybrid empirical, processed-based modeling approach	14
<i>Chad Papa.....</i>	<i>14</i>
A Wood Fuel Cost Calculator	15
<i>Eric McConnell.....</i>	<i>15</i>
Spatial Dependencies within Mississippi's Primary Forest Products Manufacturers	16
<i>Eric McConnell, Michael Crosby.....</i>	<i>16</i>
A new look at quantifying leakage in voluntary US forest carbon offset projects	17
<i>Gregory Latta, Justin S. Baker, Sara B. Ohrel, Adam Daigneault, Christopher S. Galik.....</i>	<i>17</i>
Understanding unsold timber offerings from the U.S. National Forest System	18
<i>Gregory Frey, Philadelphia Wilkens, Sonia Bruck.....</i>	<i>18</i>
Impact of hurricanes on forest market: land-use change assessment and drivers.....	19
<i>Ian Pereira Sartorio</i>	<i>19</i>
National forest timber sale price and export price interlinkages in the USA	20
<i>Jaana Korhonen, Jesse Henderson, Jeffrey Prestemon.....</i>	<i>20</i>
Forest carbon under increasing product demand and land use change in the US South	21
<i>Jesse D. Henderson.....</i>	<i>21</i>
Comovement of southern pine sawtimber stumpage and lumber futures prices in the United States	22
<i>Junyeong Choi, Jianbang Gan, Nana Tian, Matthew Pelkki</i>	<i>22</i>
ESTIMATING TIMBER SUPPLY ELASTICITIES OF PRIVATE FORESTLAND OWNERS IN SOUTH GEORGIA	23
<i>Kabindra Shahi, Jacek P. Siry.....</i>	<i>23</i>
Modeling Supply and Demand of Timber Stumpage Market in the Lake State Region	24



2022 ISFRE Meeting

New Opportunities and Challenges in Forest Resource Economics
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May 23-25, 2022, Traverse City, Michigan

Abstract Title and Authors

<i>Kyle MacLean, Andy Finley, Raju Pokharel</i>	24
Economic Significance of Wildlife Management Areas in Oklahoma	25
<i>Madison Gore, Omkar Joshi, Binod Chapagain, Neelam C. Poudyal, Sue Fairbanks</i>	25
Comparing forestry sector and general economic impacts of COVID-19 in 2020	26
<i>Matthew Pelkki, Rebecca Montgomery</i>	26
Potential Use of High-resolution Imagery to Guide Treatment Response Following Disturbance	27
<i>Michael K. Crosby</i>	27
Assessing the potential to produce biochar from low-value biomass in Michigan's forestry sector	28
<i>Nafisa Nowshin Ahmed, Raju Pokharel, Christopher Saffron, Jessica Miesel</i>	28
Feral Hog Damage Assessments in the Southern States of Arkansas, Louisiana, and East Texas	29
<i>Nana Tian</i>	29
Market coverage and competition of various wood products in Michigan	30
<i>Naresh Khanal, Raju Pokharel, Emily Huff, Jagdish Poudel, Andy Finley</i>	30
Does investing in local government capacity promote secondary forest growth?	31
Evidence from the Green Municipality Program in the Brazilian Amazon	31
<i>Nilesh Nivrutti Shinde</i>	31
Do Best Management Practices impact logger's productivity? A Stochastic Production Frontier analysis for loggers in Virginia	32
<i>Pedro Junqueira Sartori</i>	32
Currency Exchange Rate and Forest Product Trade: Evidence from US-Brazil Softwood Plywood Market	33
<i>Perceval Assogba</i>	33
Factors Affecting the Willingness to Pay for Forest Restoration at The Wilds in Ohio	34
<i>Priya Bhattacharya, Sayeed Mehmood</i>	34
Biomass Feedstock Availability and Economic Contribution of Biomass Power Facilities in the Lake States Region	35
<i>Ram Dahal, Raju Pokharel, Jagdish Poudel</i>	35
Predictors of landowner intention to manage emerald ash borer (EAB) in the central hardwood region	36
<i>Ram K. Adhikari, Neelam C. Poudyal, Thomas O. Ochuodho, Rajan Parajuli, Omkar Joshi, Sayeed R. Mehmood, John F. Munsell, Gaurav Dhungel, William Thomas, Ellen Crocker, Mo Zhou</i>	36
Assessing the impact of climate change on the pulpwood market: A case study for Brazil	37
<i>Roberto Hajime S. Kimura, Bruno da Silva</i>	37
Accounting for carbon sequestered by forest ecosystems and stored in wood products: The practices and outcomes of alternative approaches	38
<i>Runsheng Yin</i>	38
Spatial analysis of the attributes of working forest conservation easements in Georgia, USA	39
<i>Sabhyata Lamichhane, Bin Mei, Jacek Siry</i>	39
An analysis of the factors associated with forestland enrollment in property tax incentive programs in Georgia .	40
<i>Sagar Godar Chhetri, Yanshu Li</i>	40
Mississippi Timber Severance Tax and its Contribution in Regional Economy	41
<i>Sakar Nepal, Eric McConnell</i>	41
Spatially-explicit global current and potential forestry production value	42
<i>Saleh Mamun, Stephen Polasky, Brent Sohngen, Jeff Smith</i>	42



2022 ISFRE MeetingNew Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

May 23-25, 2022, Traverse City, Michigan

Abstract Title and Authors

Forest Ecosystem Services Valuation: A Choice Experiment Approach	43
<i>Saleh Mamun, Christopher R. McIntosh, Stephen Polasky</i>	<i>43</i>
Rancher's preference and willingness to pay for attributes and outcomes of non-traditional management practices: A best-worst choice experiment study	44
<i>Saroj Adhikari, Omkar Joshi.....</i>	<i>44</i>
Political Economy of Endangered Species Act Implementation—are Expenditure Decisions Political, Economic, or Ecological?.....	45
<i>Sayeed R Mehmood</i>	<i>45</i>
Economic Models for Optimal Plantation Establishment of Temperate Hardwoods	46
<i>Sayon Ghosh, Doug Jacobs, Mike Saunders, Mo Zhou</i>	<i>46</i>
A network analysis approach for assessing the availability of resources and competition for it for Michigan's logging businesses	47
<i>Shivan GC, Karen Potter-Witter, Larry Leafers, Raju Pokharel</i>	<i>47</i>
Integration of Public Farmland and Timberland REITs with their Private Equity Counterparties and Selected Asset Classes	48
<i>Srijana Baral, Bin Mei</i>	<i>48</i>
Evaluating the Impacts of the COVID-19 Pandemic on Forest-based Employment in the U.S. South	49
<i>Stephanie Chizmar, Rajan Parajuli, Erin Sills</i>	<i>49</i>
A stand level growth and yield model for oak-gum-cypress forest type in southern bottomlands.....	50
<i>Suchana Aryal, Eric McConnell.....</i>	<i>50</i>
Real options, timber insurance, and the generalized Faustmann formula under risk and uncertainty	51
<i>Sun Joseph Chang</i>	<i>51</i>
Factor endowment and structural change in Kentucky forest industry	52
<i>Thomas O. Ochuodho, Domena A. Agyeman</i>	<i>52</i>
The Informal Economy of Wiregrass Production for Longleaf Pine Restoration	53
<i>Tyler Carney, Damian Adams</i>	<i>53</i>
The Economic Value of Prescribed Burning in Northeastern Forests.....	54
<i>Arun Regmi.....</i>	<i>54</i>
Willingness to Harvest in the Lake State Region.....	55
<i>Kyle MacLean, Andy Finley, Raju Pokharel</i>	<i>55</i>
Identifying locations for biochar production from low-value biomass in Michigan	56
<i>Nafisa Nowshin Ahmed, Raju Pokharel, Christopher Saffron, Jessica Miesel</i>	<i>56</i>
Identifying hotspots to establish mass timber processing facilities and their impacts on the local economy in Michigan.....	57
<i>Naresh Khanal, Raju Pokharel, Emily Huff, Jagdish Poudel, Andy Finley.....</i>	<i>57</i>
Two birds with a stone? The Rural Environmental Registry (CAR) and Its Potential Spillover Effects Over Land Conflicts in the Brazilian Amazon	58
<i>Nilesh Nivrutti Shinde</i>	<i>58</i>
Uneven Forest Management Principles and Urban Ecosystem Services Supply	59
<i>Robert Jarred Sparks, Puskar Khanal.....</i>	<i>59</i>
Timber Supply Analysis in Arkansas: A Case Study from Magnolia City, Arkansas	60
<i>Sagar Godar Chhetri, Matthew Pelkki</i>	<i>60</i>



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New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

May 23-25, 2022, Traverse City, Michigan

Abstract Title and Authors

Economic Models for Optimal Plantation Establishment of Temperate Hardwoods	61
<i>Sayon Ghosh, Doug Jacobs, Mike Saunders, Mo Zhou</i>	<i>61</i>
Optimal Rotation Age with Stochastic Input Distribution	62
<i>Shaun M. Tanger, Bruno Kanieski da Silva, Jesse D. Henderson</i>	<i>62</i>
The Time-Varying Link of Public Timber REITs with Private Timberland, Real Estate, and Financial Assets	63
<i>Srijana Baral, Bin Mei</i>	<i>63</i>
Optimal Routing for Softwood Sawmill Supply Chain: Strategic Repair of Road and Bridge Infrastructure	64
<i>Swagat Attreya, Shaun M. Tanger, Eric McConnell, Michael Crosby</i>	<i>64</i>
The logging sector in East Texas	65
<i>Thomas Frampton, Anusha Shrestha</i>	<i>65</i>
Tour	66
<i>Tour of northern hardwood sawmill and northern hardwood forest</i>	<i>66</i>
Sponsors	67



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Abstract: Oral Presentations

Economic drivers of regional forest protection and restoration carbon leakage

Adam Daigneault, Brent Sohngen

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Professor, Ohio State University

Abstract: There long has been concern that leakage could substantially reduce the benefits of forestry programs aimed at reducing deforestation or improving forest restoration. Early studies suggested that leakage from forest protection programs could rise to as much as 90%, although empirical studies from avoided deforestation projects in the tropics have tended not to find substantial leakage. The empirical studies, however, may miss some of the impact of forest protection projects because they have thus far only captured deforestation, and have not assessed degradation, or shifts in timber harvesting. The effects of timber harvesting are difficult to assess with empirical data focused on land use change using global land use datasets. Furthermore, leakage likely varies substantially across regions, because forest growth rates, timber types, and opportunity costs differ, and it also likely varies by project type (e.g., avoided deforestation, reduced impact logging, extended rotations, afforestation). Given growing recognition of the importance of forests to meet global mitigation targets consistent with a 1.5-2°C warming threshold and the necessity to undertake projects and programs in nearly every region, it is critical to develop a global assessment that provides estimates by region and forest type.

To develop global leakage estimates, we use the Global Timber Model, and conduct a large-scale assessment of leakage across forest types, project types, and regions of the US and across the globe. Because leakage may be contingent upon the level of policy adoption in other regions or countries, we incorporate various rates of adoption of forest carbon sequestration across the globe when measuring the scale of leakage caused by project development in any particular location. The resulting analysis will provide a set of regional, forest-type specific, and project specific leakage estimates that can be applied and used by policy makers to improve the overall efficiency of forest carbon sequestration. Initial estimates suggest that leakage does vary substantially by forest and project type, although we do not find leakage rates as large as found in earlier studies. We also find that increasing adoption of forest protection and forest restoration can substantially reduce the impact of leakage over time. Scenarios that directly incorporate our leakage estimates into carbon pricing show that assuming leakage rates that are higher than the efficient rates, and that do not change over time, will substantially reduce the likelihood of achieving the high levels of forest carbon sequestration that are projected to be necessary to meet the 1.5-2°C threshold.

Keywords: Forest Carbon, Forest Sector Model, Timber Supply, Policy



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Abstract: Oral Presentations

Preferences and Willingness to Enroll in Woodland Conservation Program in Ohio USA

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Associate Professor, The Ohio State University

Abstract: The projected new developments put the private woodlands in Mid-Ohio at risk of Conversion in the coming years. Conservation programs can incentivize woodland owners to manage their woodlands for supplying ecosystem services and stall changes in land-use. Little is understood about Ohio's private woodland owners' willingness to participate and their preferred attributes for such programs. This study surveyed private woodland owners in Ohio to elicit the choice preference in a hypothetical conservation program through best-worst choice profiles and binary choice experiments. Woodland owners were asked to select the best and worst attributes of different programs and their willingness to enroll. Best-Worst scores, Conditional logistic, and Random Effects logistic regression were used to explain woodland owners' priorities. Best-Worst scores show that the highest revenue (\$100 acre/year) was the most selected attribute in all choice profiles. A non-profit program structure and no withdrawal penalty are most desirable to woodland owners besides revenue at different amounts. Both regression models show that revenue is significant and positively associated with willingness to participate, and only a withdrawal penalty of \$10/acre was not statistically significant. Private woodland owners are willing to sacrifice revenue for their preferred attributes in a program. For example, to go to a 30-year contract from a 60-year contract, woodland owners are willing to take \$24.40 acre/year less in revenue. Based on these findings, The above results can be beneficial to policy makers for planning new conservation programs that ensure the supply of crucial ecosystem services through private woodlands in Ohio

Keywords: Ecosystem Services, Willingness to accept, Best-Worst Choice, Conservation Program



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Abstract: Oral Presentations

The effect of information nudges on landowner's willingness to meet with public foresters

Ana Gutierrez, Jerrod Penn, Michael Blazier

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Assistant professor, Department of Agricultural Economics and Agribusiness, Louisiana State University

Dean, College of Forestry, Agriculture, and Natural Resources, University of Arkansas at Monticello

Abstract: Foresters offer critical guidance to landowners' management decisions regarding their forest and forest-related ecosystems. However, the evidence suggests that the majority of landowners do not resort to the services offered by foresters. The behavioral economics literature supports the employment of nudges to influence decision-making in a socially desirable way. We explore whether landowners' willingness to work with a public forester can be influenced by information nudges. Further, we test whether information nudges operate differently under hypothetical and real scenarios. For this study, we surveyed 4007 forest landowners from Arkansas and Louisiana. Our findings do not support the use of information nudges to influence landowners' willingness to work with a public forester. However, the results highlight that the landowners' decision to work with a forester and the factors driving them differ between hypothetical and real scenarios.

Keywords: Forest landowner, Public forester, Nudges



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Abstract: Oral Presentations

Managing longleaf pine forests for timber production and carbon sequestration: an optimal control analysis

Andres Susaeta

Assistant Research Scientist, School of Forest, Fisheries and Geomatic Sciences, University of Florida

Abstract: The lack of comprehensive economic analysis pertaining the management of longleaf pine (*Pinus palustris* Mill), have become an obstacle for forest landowners to restore this iconic forest ecosystem in the Southeastern United States. We present an optimal control model to determine, simultaneously, the optimal planting density, thinning schedules, harvest age and revenues of an even aged longleaf pine stand. We assume that the forest stand is managed for timber production and carbon sequestration under different site indexes– a measurement of potential forest productivity. In our numerical simulation, the rules of thinnings are determined by a maximum and minimum basal area. Our simulation results show that the optimal planting density tends to increase when longleaf pine is managed in medium and high site indexes. Our findings indicate that timber production is the main driver of economic revenues associated with longleaf pine management. Furthermore, the optimal harvest age tend to be extended with payments for carbon sequestration. The reduction of the lower limit of the basal area for thinning purposes cause a decrease in the land values.

Keywords: optimal management, land values, optimal control theory



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Abstract: Oral Presentations

The Economic Value of Prescribed Burning in Northeastern Forests

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Abstract: Prescribed fire has the potential to offer cultural and ecological benefits, and help build resilience under climate change, however, research examining the value of prescribe fire has largely focused on the benefits of reduced wildfire hazard. Both wildfire and prescribed fire occur infrequently in northeastern regions of the United States, however, there is increased interest in using prescribed fire as a forest management tool. To understand the value of prescribed burning in this region we assessed forest owner willingness to pay (WTP) for diverse categories of prescribed fire benefits and programs using Likert scales and choice experiment questions. Preliminary results indicate most forest owners have low knowledge of prescribed fire, but in some states there is also low perceptions of risk and high trust in prescribe fire implementers. Mean WTP was frequently positive and varied across states and categories of forest owners. Many respondents preferred programs that helped maintain ecosystem health and biodiversity, reduced nuisance wildlife and offered landowner assistance. We conclude demand for prescribed fire can be significant when it helps owners obtain important ecological and cultural benefits. Education and technical support will be important for expanding the prescribed fire economy in this region. The findings may help to make effective strategies to support private land burning in this region.

Keywords: Prescribed fire, willingness to pay, choice experiment, private landowners



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Abstract: Oral Presentations

A Least Cost Dynamic Optimization Approach for Obtaining a Desired Balanced Uneven-aged Structure

Basanta Lamsal, John Wagner

Graduate Student, College of Science and Forestry Environmental Science and Forestry, State University of New York

Professor, State University of New York,

Abstract: Since the 1992 Rio Summit, there has been increasing interest in modifying existing even-aged forest structures to multi-aged or uneven-aged structures. In the northeast, converting an even-aged hardwood forest to a balanced uneven-aged structure may be hindered due to the abundance of non-commercial American beech (*Fagus grandifolia*) suffering from persistent beech bark disease, which may result in negative cash flows during the conversion planning horizon. This study aimed to determine the least-cost time paths to achieve a desired balanced uneven-aged northern hardwood forest structure by a 100-year planning horizon. Forest Vegetation Simulator (FVS) was used to model growth and yield, and a dynamic program with a penalty function was used to determine least-cost time paths for two management scenarios: 1) Balanced uneven-aged structure without beech, and 2) Balanced uneven-aged structure with beech returning and removing about 67% of the more commercially valuable shade to moderate shade-tolerant species in the lower strata (<15.24 cm DBH). The penalty function allowed estimating the opportunity costs given the preference of the landowner towards economic and ecological goals. The opportunity cost increased as greater emphasis was given to ecological goals or as we moved closer to the desired structure. Sensitivity analyses revealed that the optimal paths were more stable given changes in prices and wage rates when a greater emphasis was placed on obtaining the target structure. Moreover, given the empirical example, in a forest with a high proportion of beech, the frequent harvest will neither be beneficial ecologically nor economically.

Keywords: Least-cost model, Penalty Function, Dynamic Programming, Forest Vegetation Simulator, continuous convex-q BDq structure.



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Abstract: Oral Presentations

Willingness to Pay for Deer Hunting Site Attributes using Best-Worst Choice

Bijesh Mishra, Rodney Will, Omkar Joshi

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Professor, Oklahoma State University
Assistant Professor, Oklahoma State University

Abstract: The forest-prairie ecotone of the south-central USA can provide excellent habitat for wildlife such as deer, and turkey but is slowly transitioning to closed-canopy forest largely due to absence of active management such as prescribed fire. Although active management can create or maintain suitable deer habitat, it brings an additional financial burden. Therefore, income from leasing land for deer hunting can be an important source of revenue for landowners and can offset some costs of active management. We used the best worst choice model to rank landowner preferences for deer habitat characteristics such as deer sanctuary, food plots, and forest canopy cover. We further calculated the marginal difference in willingness to pay for habitat characteristics and found that deer hunters are willing to pay higher for a lease site that provides opportunity to observe a higher number of deer. The trade-offs between opportunities to observe between 6 and 10 deer per visit, instead of 1 deer per visit, are \$9 and \$11 respectively. The willingness to pay for a lease site with food plots and deer sanctuary is also higher in comparison to others without them. Study results suggest that landowners may be able to maintain close to open canopy forest and grasslands meeting multiple objectives of cattle grazing to wildlife management without significantly compromising their revenue.

Keywords: Forest Canopy, Food Plot, Deer Sanctuary, Wildlife Management, Best-worst Choice



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A Regional Predictive Model for Maple Syrup Production in United States

Bobby Thapa, Thomas O. Ochuodho,

Graduate Student, Department of Forestry and Natural Resources, University of Kentucky
Assistant Professor, University of Kentucky

Abstract: Maple syrup, as a non-timber forest product, plays significant role in economies across regions in United States. Sustainable maple syrup production is dependent upon many factors, including forest stand dynamics, the number and size of maple trees (*Acer* spp.) suitable for tapping, and the optimal temperature range during tapping season. The interplay among these factors determine potential maple syrup production in a particular region. A stochastic production function framework is applied to establish an econometric relationship between maple syrup output and key determining factors including potential number of taps, tapping season length and temperatures, and utilization rate of potential number of taps. The model allows factors affecting output to have effect on mean and variance of the output by relating output variance to the explanatory variables in a multiplicative heteroscedastic regression framework. The model decomposes the production function into a deterministic portion related to output level and a stochastic portion related to output variability. The approach estimates explanatory variables' impacts on expected maple syrup output and its variance. Potential regional maple syrup production is estimated using the calibrated model. This model is a useful tool for maple syrup research, education, and extension in maple-producing states.

Keywords: *Acer* spp., maple syrup, stochastic model, forest inventory analysis



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Abstract: Oral Presentations

The impact of carbon-offset programs on the timber supply chain in the US South

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Research Economist, Southern Research Station, USDA Forest Service

Assistant Professor, Department of Forestry Mississippi State University

Assistant Professor, Department of Forestry and Environmental Resource, North Carolina State University

Professor, Department of Forestry and Environmental Resource North Carolina State University

Abstract: Carbon sequestration through forest management has been classified as an effective tool to mitigate the effects of climate change. Recently, private carbon offset programs have emerged to provide an alternative source of income to forest landowners; in one program, landowners commit to postpone harvesting to capture extra carbon through biological growth. Here, we evaluate how this type of management strategy can affect timber markets at a regional scale. We combine a timber supply model with FIA data and local demand to estimate spatial and temporal trade-offs between carbon and timber products in the US South. The results indicate the relationship between timber supply and carbon offset programs is highly linked to the current inventory levels within a market and their surroundings. Carbon offsets programs will reduce timber supply if their market share increases in the short term. In the long term, markets tend to find a new equilibrium and price fluctuations are minimized.

Keywords: carbon



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Abstract: Oral Presentations

Exploring the relationship between forest management and forest carbon storage and sequestration: lessons and applications from FIA data and a hybrid empirical, process-based modeling approach

Chad Papa

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Abstract: Forests provide a multitude of essential benefits such as supplying forest products, climate regulation, and carbon storage and sequestration. Furthermore, maintaining or enhancing forest carbon sinks remains an integral part to mitigating climate change. US states are increasingly interested in understanding the role forests play in reducing region wide GHG emissions especially through management activities. Where, understanding the relationship between the storage of carbon in the forest, forest carbon sequestration, and carbon stored in the forest products sector is essential to creating a sustainable bioeconomy while balancing tradeoffs between the timber supply, the forest economic sector, and other ecosystem services. In collaboration with a variety of state and federal partners, we applied the CBM-CFS3 model, a hybrid empirically driven process-based model, and its associated harvest wood products model (CBM-FHWP) to understand and explore these relationships. We incorporated data and population estimates from the US Forest Inventory and Analysis (FIA) database, remotely-sensed metrics of forest disturbance and land-use change, and TPO survey data to represent and model the effects of management activities on forest carbon storage and sequestration. Our results show promising methods to integrate FIA inventory data and an IPCC compliant carbon modeling framework to understand future effects of forest management on carbon storage and sequestration under a changing climate.

Keywords: Forest Carbon, Empirical Models, Process-Based Models, Harvest Wood Products, FIA, Forest Inventory



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Abstract: Oral Presentations

A Wood Fuel Cost Calculator

Eric McConnell

Assistant Professor, Department of Forestry,
Mississippi State University

Abstract: Escalating non-renewable energy prices will make procuring woody biomass to fuel mill conversion processes more attractive once again. A wood fuel cost calculator was constructed in Microsoft Excel to help mill procurement agents make more informed decisions regarding woody biomass, such as hog fuel, in-woods chips, or processing residuals. The calculator's "mill cost" function sourced methods and data from the Wood Fuel Handbook. Entering mill data gathered from the scalehouse, including load weight, cost, and moisture content, deduces wood fuel's competitiveness with natural gas; more precise information can be gained by entering laboratory findings regarding wood chemistry. The "procurement maximum" function was sourced from Greene et al. (1992, Empirical supply curves for green residuals from primary forest products mills in Arkansas) and Kluender and Greene (1993, Estimating Supply Curves for Green Residuals from Primary Forest Product Mills). Using the same data per load as before, maximum price payable (fob mill) for that particular load can be determined. Secondly, the recommended maximum average wood fuel price (fob mill) payable within a procurement radius is provided. Lastly, the maximum procurement distance is displayed, provided the mill always pays the maximum price and the wood fuel can be bought for \$0 at the greatest distance. Information such as this will help mills objectively review their costs as inflationary concerns across the nation's economy heighten.

Keywords: Biomass; Energy; Mill Costs; Wood Procurement



2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

**Spatial Dependencies within Mississippi's Primary Forest Products
Manufacturers***Eric McConnell, Michael Crosby*

Assistant Professor, Department of Forestry, Mississippi State University

Assistant Professor, School of Agricultural Sciences and Forestry, Louisiana Tech University

Abstract: This study identified whether wood-using mills' locations spatially depended upon timber product harvest levels and the number of complementary species group mills within and between counties in Mississippi. County mill count for either the pine or hardwood timber industry was the dependent variable. County timber product harvest levels (thousand green tons) for pine sawtimber, pine pulpwood, and pine poles along with count of hardwood mills were predictors for the pine model; hardwood sawtimber, hardwood pulpwood, and the number of pine-type mills served likewise for the hardwood model. Poisson regression models were constructed and augmented to Spatial Lag of X models where spatial dependency within 100 miles of a county's centroid was identified.

Direct effects of pine product harvesting were absent. Thus, pine mills were not located based on own-county timber resources. Some evidence for hardwood mills supporting pine mill count was found ($t = 1.65$, $p = 0.0987$). Own-county pine pulpwood harvests positively influenced pine mill counts in neighboring counties ($t = 3.21$, $p = 0.0013$) as did pine sawtimber to a lesser degree ($t = 1.77$, $p = 0.0766$); pine pole harvests produced the opposite effect ($t = -1.96$, $p = 0.0505$).

Competition for pine sawtimber and pulpwood increased as procurement radii increased. Greater hardwood pulpwood harvesting ($t = 4.44$, $p < 0.0001$) and pine mill count ($t = 2.70$, $p = 0.0085$) indicated a significant own-county hardwood mill presence. This finding is germane to log trucking output, wood utilization efficiency, standing timber prices, and consequently forestland value.

Keywords: Hardwood; Pine; Pulpwood; Sawtimber; Wood Mills



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2022 ISFRE Meeting

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

May 23-25, 2022, Traverse City, Michigan

Abstract: Oral Presentations

A new look at quantifying leakage in voluntary US forest carbon offset projects

Gregory Latta, Justin S. Baker, Sara B. Ohrel, Adam Daigneault, Christopher S. Galik

Associate Research Professor, Department of Natural Resources and Society, University of Idaho

Department of Forestry and Environmental Resources, North Carolina State University

United States Environmental Protection Agency

School of Forest Resources, University of Maine

Department of Public Administration, North Carolina State University

Abstract: With renewed public and private sector interest in climate change mitigation, there is an urgent need for the scientific community to advance empirical and modeling methods to evaluate potential implications of forest carbon offset (FCO) program design. Such analysis is critical for informing offset protocol development in several ways, including for estimating key protocol parameters such as leakage rates. Currently, protocol developers are applying leakage rates based on dated research and modeling approaches that no longer reflect contemporary market dynamics, forest inventories, and management practices. This analysis explores some of the potential issues related to using structural models of the US forest sector to evaluate leakage within a hypothetical FCO program. We simulate the voluntary FCO market participation across a wide-range of carbon price scenarios (ranging \$5- \$100/tCO₂eq), and then track forest carbon changes domestically over time across both market participant and non-participant pools relative to a baseline (no carbon price) scenario. We next compare leakage rates for scenarios that pay for only annual removals with those that only pay for avoiding emissions from harvesting mature forests. Finally, we isolate the FCO to single regions and evaluate the inter- and intra-regional changes in carbon pools. The results provide a robust base on which to explore further FCO program design issues.

Keywords: climate change mitigation, forest carbon offset



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International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Understanding unsold timber offerings from the U.S. National Forest System

Gregory Frey, Philadelphia Wilkens, Sonia Bruck

Research Forester, Southern Research Station, USDA Forest Service

Abstract: Timber sales from the U.S. National Forest System can provide ecological and economic benefits. Unsold (“no-bid”) offerings can result in delays, additional cost, and missed targets. We sought to understand situations that are variously considered “no-bid” offerings by different stakeholders, measuring prevalence, identifying causes of “no-bid” offerings, and generating a framework for communicating interlinkages. Over 2007-2020, the timber volume not sold at first offering was 11.9% nationally. However, a substantial amount is sold subsequently, leaving 2.7% never sold. The Regions with the highest percentage that never sells include Alaska, Southwestern, and Pacific Southwest. A new conceptual framework developed from literature review, interviews with NFS and industry employees, and a survey of NFS employees, identified prominent proximate causes and underlying factors and their relative importance regionally. Proximate causes include road construction, equipment requirements, and timber condition; whereas underlying factors include staffing, communication, and appraisal methods. These insights can aid internal and external communication, and set the stage to develop future strategies.

Keywords: Timber sales; appraisal; public land management; unsold timber offerings



International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

May 23-25, 2022, Traverse City, Michigan

Abstract: Oral Presentations

Impact of hurricanes on forest market: land-use change assessment and drivers

Ian Pereira Sartorio

PhD Student, Department. of Forestry, Mississippi State University

Abstract: Dealing with hurricanes disturbances is among the greatest challenges of the forest sector in the Southern US. Hurricanes lead to immediate damage to forests and financial losses for landowners. Further, changes in inventory and prices extend the economic impact of hurricanes to all stages of the forest products supply chain. This study aims to estimate the change in forest areas related to timber damage and harvest activity after a hurricane. Using data about weather conditions, forest structure, and the timber markets, we tested a set of statistical and machine learning models, such as the Probit model, Logistic regression, Random Forest, and K-Nearest Neighbors, to identify the main drivers of forest change and predict the areas with a high probability of conversion. Results indicate that forest age has the highest impact on conversion, with a negative effect, followed by wind speed and distance to the hurricane's center, which have a positive and negative effect, respectively (younger ages, higher wind speeds, and lower distances increase the likelihood of conversion). Amongst the models, the Random Forest algorithm had better performance, especially with SMOTE and Tomek-Links sampling techniques. From obtained results, timber volume can be estimated, generating quality information to help decision-makers achieve better overall results when managing these events.

Keywords: Hurricane disturbance, Timber damage, Salvage logging, Modelling, Machine learning.



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

National forest timber sale price and export price interlinkages in the USA*Jaana Korhonen, Jesse Henderson, Jeffrey Prestemon.*

Postdoctoral Researcher, Oak Ridge Institute for Science and Education (ORISE)

Research Economist, Southern Research Station, USDA Forest Service

Project Leader, Southern Research Station, USDA Forest Service

Abstract: The aim of the research is to understand structure and special arrangement of timber markets in the U.S. West Coast (USDA regions 5 and 6) and the U.S East Coast (USDA regions 8 and 9). All these regions are important areas for global roundwood production. Their local market conditions differ significantly e.g., in terms of climate, species composition and forest ownership structure, warranting an interesting context for the analysis.

More specifically, we aim to understand the interrelationship of national forest bid and export price for Douglas Fir (region 5,6) and southern Yellow Pine (region 8,9) in 2002-2021 by applying time-series stationarity and Bounds-testing approaches.

The analysis shows the difference in time series properties across different geographies and time-periods. The national forest timber markets prove to be stationary across the different regions, while export prices appear non-stationary with an exception for region 5. While cointegrating relationships exist between the national and export timber prices for the region 6, 8 and 9, the statistical significance of the national and export prices varies depending on the region and the period. The national forest prices are the most integrated with export prices in region 6, where the majority of forests are owned by federal and state governments.

The results of this study provide new insights on how local markets are connected to regional and higher-level markets. Consequently, we discuss the consequences of these results on the economic feasibility of timber harvests and highlight their implications for local harvest and global sector models.

Keywords: export price, bid



International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Forest carbon under increasing product demand and land use change in the US South

Jesse D. Henderson

Research Economist, Forest Economics and Policy, USDA Forest Service

Abstract: Recent announcements for sawmills and wood pellet mills could lead to increased timber demand in the US South. We examine the impacts on forest carbon from these demand increases with an empirical forest sector model, coupled with an endogenous land use change model that differentiates the impacts of population, income, and land rents among forest types. We explore the sensitivity of forest carbon to a suite of scenarios combining high or low sawtimber and wood pellet demand with shared socioeconomic pathways (SSPs), which influence development and constrain the land area available for forestry. Our results identify the tradeoffs and relative impacts among product demands and SSPs and provide new insights on the sustainability of wood pellets.

Keywords: forest carbon, timber supply, bioenergy, land use change



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Comovement of southern pine sawtimber stumpage and lumber futures prices in the United States

Junyeong Choi, Jianbang Gan, Nana Tian, Matthew Pelkki

Ph.D. Student, Department of ecology and conservation biology, Texas A&M University

Professor, Department of ecology and conservation biology, Texas A&M University

Assistant Professor, Forest Resources Center, University of Arkansas at Monticello

Professor, Forest Resources Center, University of Arkansas at Monticello

Abstract: Lumber futures and southern pine sawtimber prices in the United States have shown different volatilities and routes of movement in recent years, especially during the COVID-19 pandemic. This has raised questions about their fundamental relationship and concerns about their asymmetric impacts on different stakeholders including timberland owners and lumber producers and consumers. We employed wavelet analysis to examine this phenomenon using the weekly averages of softwood lumber futures and southern pine sawtimber stumpage prices from August 2011 to July 2021. We found that these two prices followed a complex pattern of comovement that varied with time and frequency. Their comovement at high frequencies lasted only for short periods and did not display a clear pattern whereas their comovement at lower frequencies has strengthened and been led by the lumber price since 2014. These findings are of interest and value to various stakeholders as they position themselves in the post-Pandemic era.

Keywords: Softwood lumber; Southern pines; Futures price; Stumpage price; Wavelet analysis; COVID-19



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

ESTIMATING TIMBER SUPPLY ELASTICITIES OF PRIVATE FORESTLAND OWNERS IN SOUTH GEORGIA

Kabindra Shahi, Jacek P. Siry

Graduate Student, Warnell School of Forestry and Natural Resources, University of Georgia
Professor, Warnell School of Forestry and Natural Resources, University of Georgia

Abstract: In the US South, private forestland owners own the majority of timberland, therefore, understanding timber supply from these owners is a fundamental forest economic question. This study estimates the timber supply equations and elasticities of private owners of TimberMart-South (TMS) Georgia region 2 (GA2). It uses individual owner stumpage sales data from 2010 to 2019 obtained from TMS and employs two-stage least regression (2SLS) for the analysis. Over the study period, sawtimber price has slightly decreased, while chip-N-saw (CNS) and pulpwood price exhibit the reverse trend. The regression results revealed that pine pulpwood stumpage volume was price inelastic (0.270), whereas pine sawtimber stumpage volume was almost unit price elastic (0.98). Furthermore, there was significant negative effect of sawtimber price on pulpwood volume supplied and vice-versa, however, the effect of the former was larger in magnitude. This unique study provides the empirical basis to make informed decisions for timber buyers.

Keywords: Price Elasticity, Private Forestland Owners, Stumpage Price, TimberMart- South Georgia Region 2 (TMS GA2), Timber Sales



International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Modeling Supply and Demand of Timber Stumpage Market in the Lake State Region

Kyle MacLean, Andy Finley, Raju Pokharel

Graduate Student, Department of Forestry, Michigan State University

Professor, Department of Forestry, Michigan State University

Assistant Professor, Department of Forestry, Michigan State University

Abstract: The aim of this study is to describe lake state timber markets' supply and demand, in addition to how they react to changes in prices of inputs or outputs. The study analyzes demand and supply in the Lake State region by modeling price and inventory data using Johansen's multivariate integration approach under a vector error correction model. Using bi-annual seasonal stumpage price data from 2012 to 2021 and USFS FIA inventory data, analysis estimates significance for coefficient values of demand, supply, and respective elasticities. The results of this analysis can be utilized by forest researchers and timber investment shareholders to investigate economic effects of new programs or the viability of forest treatments.

Keywords: Timber, prices, market modeling, economics



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Economic Significance of Wildlife Management Areas in Oklahoma*Madison Gore, Omkar Joshi, Binod Chapagain, Neelam C. Poudyal, Sue Fairbanks*

Graduate Research Assistant, Oklahoma State University

Assistant Professor, Oklahoma State University

Postdoctoral Fellow, University of Tennessee

Associate Professor, University of Tennessee

Associate Professor, Oklahoma State University

Abstract: The establishment of public recreation lands such as Wildlife Management Areas (WMAs) involves significant costs in terms of the acquisition, protection, and maintenance. Given inherent costs, state wildlife agencies and other conservation organizations interested in expanding more land into the WMA system may benefit from the information pertaining to the economic valuation and contribution of WMAs. To characterize the economic significance of WMAs, this study assessed two different metrics of economics, the net economic benefits of site access to visitors and the economic impacts of visitor spending to the state economy. To accomplish the study objectives, WMA visitor surveys were administered among 2,997 residents and non-residents who held an Oklahoma hunting and fishing license or conservation passport during 2020-2021. Results from a travel cost model showed that the net benefit of WMA access per trip is \$56.71-\$101.27, which if aggregated to the population of WMA users in Oklahoma, becomes \$169-\$301 million, depending upon modeling assumptions. A statewide input-output economic analysis showed that WMA-related spending, directly and indirectly, created a total of 10,225 jobs that provided a labor income of \$403 million and contributed a total of \$58 million and \$78 million in state and local, and federal taxes, respectively in Oklahoma in 2020. Results from this study demonstrate the economic importance of WMAs in Oklahoma and help wildlife agencies justify the investment of public funds in future land acquisitions for WMA and other similar conservation areas.

Keywords: wildlife management areas, economic significance, consumer surplus, economic impacts



International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Comparing forestry sector and general economic impacts of COVID-19 in 2020

Matthew Pelkki, Rebecca Montgomery

Director and Economic Analyst, Arkansas Center for Forest Business

College of Forestry, Agriculture, and Natural Resources, University of Arkansas at Monticello

Abstract: Arkansas is the third-most forest dependent economy in the United States. As such, the impacts of COVID-19 on the forest economy and general economy of Arkansas differed by county and region of the state. Using IMPLAN data for 2019, 2020Q1, 2020Q2, and 2020, we compared the direct effects of the pandemic on forestry sectors and the 10 largest sectors for all 75 counties in Arkansas and the entire state. A comparison of forest industry intensive counties with counties whose forest industries represent a small part of the total economic activity revealed differences in pandemic effects. In counties with southern pine sawmills the economic activity increased in 2020Q2 and 2020Q3 and then returned to the 2019 levels by the end of 2020. In counties with pulp mills, the pandemic resulted in steady declines throughout 2020 with little or no recovery. Those counties with containerboard and paperboard mills experienced strong recoveries in 2020Q4. Overall, the pandemic impacts were expressed more slowly in the forest products industry in 2020. However, when the general economies recovered in 2020Q4, forest economies continued to decline. Statewide, indirect and induced effects fell at a higher percentage than direct effects as household spending throughout the economy declined.

Keywords: contribution analysis, IMPLAN, economic development



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International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Potential Use of High-resolution Imagery to Guide Treatment Response Following Disturbance

Michael K. Crosby

Assistant Professor, School of Agricultural Sciences and Forestry, Louisiana Tech University

Abstract: Prioritizing resource allocation in the wake of a forest disturbance is an important step in mitigating further risk to the forest. High-resolution imagery provides a means of detecting the impacts of disturbance quickly and accurately and provides a way to estimate areas and corresponding treatments for disturbed areas. An outbreak of Southern Pine Beetle (SPB) occurred on the Bienville National Forest between 2015-2019. Worldview-2 imagery was acquired in 2017 and Principal Components Analysis was utilized to determine areas being actively infested by SPB. The areas delineated using this method were compared against treatment between the image date (October 2017) and 2018 image analysis to quantify infested areas treated and estimate costs of treatment for cut-and-leave operations. This method provides insight into spectral responses of pine species to SPB attack and allows for the determination of infestation and could be used to provide a cost estimate to mitigate spread throughout the forest.

Keywords: High-resolution imagery, Principal Components, SPB, Disturbance



International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Assessing the potential to produce biochar from low-value biomass in Michigan's forestry sector

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Associate Professor, Department of Biosystems and Agricultural Engineering, Michigan State University

Associate Professor, Department of Plant, Soil and Microbial Sciences, Michigan State University

Abstract: Biochar is a form of pyrolyzed carbon that has proven to amend soils in agriculture and has been known to sequester high rates of carbon. About 53% of Michigan is forested lands, which is facing an issue of utilizing low-value wood products and logging residues and increasing the risk of pathogen outbreaks and fire. This study is designed to improve the utilization of such wood products to produce biochar at optimally placed locations by identifying hotspots of biomass availability (feedstock) and competition from existing biomass users. To accomplish this, we overlay competition hotspots maps, resource availability maps, and other qualitative information to identify the cost-optimal locations for new facilities. Then we estimated the available feedstock drawing procurement zones around these facilities with current delivered wood prices and inventory data from the FIA database. After an initial qualitative assessment of biomass availability from forests, primary and secondary mills, Marquette in the Upper Peninsula and Grand Traverse in the Lower Peninsula have been found suitable as ideal locations to establish prospective biochar processing facilities. The outcome of this study will bridge the knowledge gap on biochar production and commercialization, connecting landowners, foresters, and policymakers toward developing policies on biomass and biochar. We hope that this analysis will encourage stakeholders to prioritize designing resource utilization-based solutions, such as biochar, and consider the role they can play in building a

Keywords: logging residues, competition hotspot maps, procurement zones



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International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Feral Hog Damage Assessments in the Southern States of Arkansas, Louisiana, and East Texas

Nana Tian

Arkansas Forest Resources Center, College of Forestry, Agriculture & Natural Resources, University of Arkansas at Monticello

Abstract: Feral hog (*Sus scrofa*) as an invasive species in the U.S. has caused severe damage to natural resources through competing for food resources by eating domestic livestock and destroying habitat by rooting and wallowing. Given increased populations and wide distribution in the southern states of United States as well as the costly damages they inflict, feral hog is becoming an urgent issue for both natural resource managers and landowners. Three state-wide surveys were developed to elicit damage estimates related to feral hog activities in each of the state's counties/parishes of Arkansas, Louisiana, and East Texas. Surveys were conducted in the summer of 2021 and were mailed to 4,500 agricultural producers and landowners. Results suggested that landowners in those three states believe that the most important types of damage from feral hog were rooting/grubbing, crop-damage, wallows, pastures, food plots, consumption of grain/hay, as well as loss of land value. Soybean damage was the most important agriculture crops damage in both Arkansas and Louisiana while it was hay, silage, and forage crops in Texas. In terms of livestock damages, beef cattle and calves was the most severe damage from hogs in all three states. Those findings could help both landowners and wildlife management personnel understand the negative societal impact of feral hogs; and they could also facilitate the comparison between expected benefits and costs of control programs/options for feral hogs in the southern states.

Keywords: Feral Hog; Damage; Southern States; Survey; Land-use;



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Market coverage and competition of various wood products in Michigan*Naresh Khanal, Raju Pokharel, Emily Huff, Jagdish Poudel, Andy Finley*

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Assistant Professor, Department of Forestry, Michigan State University

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Professor, Department of Forestry, Michigan State University

Forest Economist, Forest Resource Division, Michigan Department of Natural Resources

Abstract: Wood processing facilities are important stakeholders in forest conservation and management. On one hand, they generate revenues and direct employment to people, and on the other hand, they directly contribute to active forest management generating revenues. The main objective of this study is to assess the market coverage and competition of various wood products in Michigan and compare how the coverage has been changed over the last four decades. By utilizing the road network and locations of milling facilities in Michigan, I run network analysis in ArcGIS to generate the procurement zones around each wood product facility. I categorized milling facilities into four main types based on the forest product they use; softwood sawtimber, hardwood sawtimber, pulpwood, and biomass. These zones represent the economically feasible regions to haul raw forest materials. I then overlay these procurement zones to create coverage and competition hotspots. Finally, the coverage and competition maps are overlaid with forest ownership maps. Hence, I was able to compare how the coverage and competition of milling facilities have changed in the last four decades along with a change in forest cover. The findings deliver the best available options for economically feasible supply regions and market extent for wood products merchantability in Michigan. Additionally, the findings will help to present the impact on forest market coverage due to the economic recessions and restricted harvesting of the national forests. The findings will be helpful in supporting policies and incentive discussions to facilitate forest product market development in Michigan.

Keywords: biomass merchantability, network analysis, procurement zones, mills dynamics



2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Does investing in local government capacity promote secondary forest growth?**Evidence from the Green Municipality Program in the Brazilian Amazon***Nilesh Nivrutti Shinde*

Ph.D. Candidate, Department of Forest Resources and Environmental Conservation, Virginia Tech

Abstract: Programa Municípios Verdes (PMV), or the Green Municipality Program in the State of Pará, began to support consolidating rural property's Rural Environmental Registration (Portuguese: Cadastro Ambiental Rural, CAR) to combat deforestation and forest degradation in the state of Pará. PMV strengthens sustainable rural production via strategic actions of environmental-land ordering and environmental management, focuses on local pacts, monitors deforestation, implements the CAR, and structures environmental management at the participating municipalities (PMV, 2021). We assess the municipality's self-participation in the PMV to have a spillover effect in expanding the secondary forest area's extent (in Sqkm at the municipal level). The PMV is a voluntary program where municipalities that choose to participate benefit from a set of economic incentives. We utilize a robust quasi-experimental approach of generalized synthetic control that compares a municipality's outcome with a weighted synthetic control group generated from non-participating municipalities to handle self-selection. Our results show that PMV fostered the growth of the secondary forest area in participating municipalities. The treated cohort average treated effects on treated (ATT) shows a 14.45 unit increase in secondary forest extent. Moreover, the young secondary forest (age 1 to 8) expanded faster than mature secondary forests (9 to 24). The treated cohort exhibits a 6.6 unit loss of secondary forest per year while it has a 24.1 unit increase. Lastly, we conduct robustness checks using the matrix-completion technique, which shows improved matching of pre-treatment trends in the extent of the secondary forest and ATT of a 7.31 unit increase.

Keywords: secondary forest growth, the Green Municipality Program, generalized synthetic control and Brazil



International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Do Best Management Practices impact logger`s productivity? A Stochastic Production Frontier analysis for loggers in Virginia

Pedro Junqueira Sartori

PhD Student, Department of Forest Resources and Environmental Conservation, Virginia Tech

Abstract: Understanding and exploring the relationship between timber harvesting capital value and labor time dispensed in implementing Best Management Practices (BMPs) and logger`s productivity is essential for the feasibility and expansion of sustainable forest management and logging. We develop a sustainable logging Stochastic Production Frontier model that we apply to firm-level operational data collected with over 400 loggers in Virginia, United States, in 2014 and 2019. We estimate the marginal contribution of a diversity of firm and logger characteristics to operational productivity, including BMP implementation effort, which helps us to understand if and how BMP implementation contributes to efficiency. We find that logging equipment value, harvesting area, region (mountainous versus non-mountainous), and number of loggers in the woods present statistically significant impact on logger`s productivity, as expected. However, time spent implementing BMPs, along with other logger characteristics (such as education level), does not show a statistically significant impact on logging productivity. Firm average efficiency rate was 63% and 62% for the 2014 and 2019 years, respectively. These results highlight that there are significant improvement opportunities for efficiency gains in the logging industry of Virginia, and that such improvements may be achieved through higher investment and new technology adoption. Moreover, while BMPs do not contribute to logging firm's efficiency, they also do not reduce it, which means that efficiency gains may be achieved with and, maybe even through, sustainable harvesting techniques.

Keywords: Best Management Practices, Productivity, Stochastic Production Frontier



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International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Currency Exchange Rate and Forest Product Trade: Evidence from US-Brazil Softwood Plywood Market

Perceval Assogba

Assistant Professor, Forest Economics and Management, University of Tennessee

Abstract: This study investigates the effect of currency exchange rate on U.S.-Brazil softwood plywood market and the welfare distribution of U.S. dollar's strengthening with respect to Brazilian real between 2010 and 2019. The Equilibrium displacement modelling approach is adopted. The results both in the short-run and long-run show that the pass-through effect of U.S. dollar's appreciation is more perceptible to U.S. consumers when U.S. faces a relatively elastic export supply curve from Brazil. Although, the U.S. dollar's strengthening with respect to Brazilian real had a detrimental effect on U.S. domestic producers of softwood plywood, the gains to U.S. consumers more than offset the losses to U.S. producers.

Keywords: Softwood plywood, exchange rate, pass-through elasticity, welfare distribution



2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Factors Affecting the Willingness to Pay for Forest Restoration at The Wilds in Ohio*Priya Bhattacharya, Sayeed Mehmood*Graduate Research Associate, School of Environment and Natural Resources, The Ohio State University
Associate Professor, School of Environment and Natural Resources, The Ohio State University

Abstract: Since the creation of Surface Mining Control and Reclamation Act in 1977 over 6,000 km² of the Appalachian forests has been mined, many of which although reclaimed have not been reforested yet. The Wilds in Ohio is a 9,154-acre reclaimed coalmine serving as a conservation center and an ecotourism destination. A willingness to pay (WTP) survey was conducted to estimate the amount visitors were willing to contribute toward reforestation, if carried out by The Wilds. The participants were presented with a hypothetical scenario where they were asked about their WTP for restoring areas of two different acreage. Three out of five groups were presented with the information about the benefits and challenges of coalmine restoration. The average WTP amounts ranged from \$47 to \$94 depending upon the treatment. Results showed that providing additional information did not affect WTP significantly, neither did acreage. However, when the WTP for two different acreage was asked together in the same survey, the amounts were significantly different. The results also showed that some of the factors significantly affecting the decision to pay were support for restoration, donation to other charitable organizations, awareness of Wild's mining history, and awareness of ecosystem services, whereas how much to pay was affected by overnight stay, income, importance placed on ecosystem services and belief in the efficacy of restoration in providing the services. These results suggest that restoration efforts could be funded directly by the public when conducted by an organization that has a steady flow of visitors.

Keywords: forest restoration, WTP, The Wilds, visitor survey



2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Biomass Feedstock Availability and Economic Contribution of Biomass Power Facilities in the Lake States Region*Ram Dahal, Raju Pokharel, Jagdish Poudel*

Forest Economist, Wisconsin Department of Natural Resources
 Assistant Professor, Department of Forestry, Michigan State University
 Forest Economist, Michigan Department of Natural Resources

Abstract: Power generation utilizing forest biomass in the United States has grown over time and has been advocated as a renewable feedstock supporting economic and environmental objectives. In this paper, we employ IMPLAN to estimate the economic contribution of wood-based biomass power generation at fifteen different scenarios which include five demand scenarios with capacity conversion and ten supply scenarios with feedstock or biomass availability. To estimate the potential supply of biomass, we estimate net annual woody biomass increase (NAWI) in each of the powerplants procurement zones at average delivered wood prices (\$23.25/Gt) in the lake states followed by 5-20% increase or decrease in the prices (\$18.60-27.90/Gt). The procurement zones were derived using the haul time as a surrogate of transportation cost. In 2019, biopower generation supported 456 direct jobs and 2,745 jobs through support activities and industries producing \$780 million total output in the regional economy. Approximately, 9.72 million dry tons of NAWI were available at the average delivered wood prices within the procurement zone of biomass facilities in the lake states region. If all of this biomass is utilized for biopower generation, this industry would produce 9,529 total jobs (6,784 jobs addition to current scenario). The total output to the economy will increase by \$1,037 million of direct gross output generating \$1,254 million (\$893 million in additional to current scenario) through support activities and industries. Economic contribution estimates and economic feasibility analysis from this study offer valuable information to policy makers and other stakeholders to communicate the importance of these sectors.

Keywords: Biomass, IMPLAN, Procurement zones, NAWI, Transportation cost



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Predictors of landowner intention to manage emerald ash borer (EAB) in the central hardwood region

Ram K. Adhikari, Neelam C. Poudyal, Thomas O. Ochuodho, Rajan Parajuli, Omkar Joshi, Sayeed R. Mehmood, John F. Munsell, Gaurav Dhungel, William Thomas, Ellen Crocker, Mo Zhou

Postdoctoral Research Associate, University of Tennessee

Abstract: Emerald Ash Borer (EAB) has been a significant threat to native ash species in the Central Hardwood Region of the United States causing unprecedented economic damage over the past two decades. As most of the forest land in the region is privately owned, it is critical to assess the knowledge and behavioral intentions of forest landowners to effectively manage EAB. By conducting a mail survey of landowners in Kentucky, a state with major EAB infestation, we analyzed whether and how landowners personal and psychosocial characteristics influence their intention to managing EAB. Results from a regression model grounded on the theory showed that subjective beliefs such as risk perception, collective efficacy, knowledge on control methods, and importance of group efforts were positively related to landowner intention to manage EAB. Likewise, landowners who owned land for economic goal were more likely to participate in EAB monitoring and controlling efforts than landowners with other ownership goals. However, landowner with EAB damage were less likely to engage in EAB management. Findings imply that outreach programs, collaborative efforts, and demonstration of successful examples can help improve landowner participation in EAB management in the region.

Keywords: ash tree, control option, landownership goal, invasive insect, subjective belief



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Assessing the impact of climate change on the pulpwood market: A case study for Brazil

Roberto Hajime S. Kimura, Bruno da Silva

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Assistant Professor, Department of of Forestry at Mississippi State University

Abstract: Climate change will have a profound impact on the environment and economy in the upcoming decades. We investigated the effect of climate change on the supply chain in the state of Mato Grosso do Sul, in Brazil, which is among the few markets in the world announcing new pulp mills in the next few years. Between 2000 and 2022 the demand for pulpwood increased from zero to 11 million tons, leading to an expansion of around 700 thousand hectares of Eucalyptus plantation. In 2024, a new pulp mill will start operating and will increase the consumption of wood fiber by 8.2 million tons or 49%. We used mathematical programming to investigate how different scenarios of productivity will affect the market dynamic, by looking at extreme climate scenarios (positive and negative). Our results showed that around 57 thousand hectares (+8%) of additional timberland will be necessary for the upcoming decades. The first impact will be an increase in the pulp production cost of around US\$5 billion or 4.1% in 15 years. These results enlighten the risks associated with losses in the productivity of forests due to climate change. If the rate of land cover change keeps constant at around 1.3%/year, the broad development of the local market would be constrained, discouraging future investments, and reducing potential positive externalities in the region.

Keywords: Linear programming, global warming, forest economics, scenarios analysis, resource allocation



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Accounting for carbon sequestered by forest ecosystems and stored in wood products: The practices and outcomes of alternative approaches

Runsheng Yin

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Abstract: In deliberating forest-based carbon accounting and credit taking, inconsistencies and confusion abound regarding how timber and carbon are treated as joint products, whether the rules of additionality and permanence are followed, and if the differentiated durations of harvested wood products (HWPs) are captured. Here, we tackle these issues by establishing a more adequate analytic framework and exploring the practices and outcomes of alternative approaches. We show that properly accounted for, forest sector efforts of emission offsetting are important and creditworthy and, thus, deserve to be seriously promoted and financially rewarded. In the case of intensively managed pine plantations in the U.S. South, the impact of adding carbon to valuation on the optimal rotation is little, while that on the total/net revenue is substantive. Further, the different service lives of HWPs, coupled with the additionality and permanence rules, call for more integrated and thorough assessment of the potentials of forest sector climate solutions.

Keywords: Carbon accounting, emission offset, additionality, permanence, joint production



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May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Spatial analysis of the attributes of working forest conservation easements in Georgia, USA

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Professor, Warnell School of Forestry and Natural Resources, University of Georgia,
Professor, Warnell School of Forestry and Natural Resources, University of Georgia

Abstract: There is a rising interest in creating conservation easements to promote a range of ecological, recreational, and economic values. There have been an increasing number of easements that protect working forest by restricting development while allowing the forest management practices. As the ownership differs, attributes of working forest conservation easements such as forest management activities, landowners' goals and motivations, landscape features and land use vary greatly. Assessing the trends and patterns in these different attributes of working forest conservation easements across the landscape can help us better understand the conservation, ecological and economic implications. In this study, we analyzed various spatial relationships of easement attributes including easement goals, land use types, recreation opportunities, hydrological features, and forest management activities in Georgia. Data was retrieved by text mining the easement contracts and the baseline reports. Results revealed a positive spatial autocorrelation in easement goals and land use types, but not in forest management activities. Clusters of easements with similar attributes were identified using local indicators of spatial association and were visualized in maps. The findings are useful in understanding the concentrations and variations of the attributes of working forest conservation easements and serve as a working guide with regard to easements in Georgia that can be used by landowners, conservation groups, and/or federal agencies.

Keywords: land use, spatial analysis, timberland investment



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

An analysis of the factors associated with forestland enrollment in property tax incentive programs in Georgia

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Assistant Professor

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Abstract: In Georgia, property tax remains one of the top concerns of private forest landowners, since it reduces the profitability of timber investment and may contribute to forest parcelization and fragmentation. The Georgia General Assembly has introduced property tax incentive programs such as Conservation Use Valuation Assessment (CUVA) and Forest Land Protection Act (FLPA) to provide tax relief for qualifying forest landowners and sustain public benefits from the forests they own. The study aims to identify the factors associated with Georgia forest landowners' enrollment in these two programs and assess the effectiveness of the programs in conserving forestland. A multilevel logistic regression model was employed to identify the factors on the enrollment decision. The results revealed that the majority of the Georgia foresters were enrolled under preferential property tax incentive programs. Forest size, distance to city, enrollment status of neighbor parcels, land productivity, and the tax-saving amount had significantly positive effects on a parcel's enrollment in the programs, while the distance to specified conservation areas, county population density, absentee landowners, and county forest cover ratio had significantly negative effects on enrollment. The acreage and percentage of enrolled forestland suggested that incentive programs have attracted a significant amount of qualifying land and contributed to conserving forests in Georgia. However, the effectiveness of these programs is limited in attracting parcels near urban areas and lakes.

Keywords: landowners, enrollment, CUVA, FLPA, multilevel logistic regression model



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Mississippi Timber Severance Tax and its Contribution in Regional Economy

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Abstract: Mississippi's timber severance tax, levied on per unit of harvest basis, was authorized by the legislature to discourage wasteful cutting of timber and support private forest landowners through Forest Resource Development Program (FRDP). However, most landowners are unaware of FRDP, and they perceive severance tax as an impediment. To uncover the real economic implications of the severance tax and FRDP in recent times, the contribution of the severance tax and FRDP to Mississippi's economy was analyzed. The contribution analysis was done using modified Leontief's input-output model that uses the coefficients from IMPLAN 2019 and Emsi. The imbalances between the input and output totals were reconciled using the RAS method to obtain the final Leontief's inverse matrix. The total funds allocated for the FRDP and counties in 2019 were run as final demands, and the total possible impact was estimated to be \$6.2 million in industrial output and 223 full-time and part-time employment. However, only about 70% of the FRDP funds were expended in that year, and the actual contribution was short by \$1.36 million in output and 57 full-time and part-time employment. The results of the study highlighted the necessity of extension services to promote FRDP among landowners.

Keywords: Severance tax, FRDP, Input-output analysis



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Spatially-explicit global current and potential forestry production value

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Department of Agricultural, Environmental and Development Economics, The Ohio State University
High Meadows Environmental Institute, Princeton University

Abstract: Understanding net economic returns for alternative land uses is critical in land-use decisions. Managed forestry is a major land-use class globally - occupying 540 million acres and generating 559.47 billion USD annually. Yet, we lack a consistent, spatially-explicit global dataset of forestry production value. In this article, we propose a method for creating a spatially-explicit dataset of global managed forestry production value. We provide estimates of both the current managed forestry production value as well as potential managed forestry production value. Using an MC2 vegetation scenario to identify forest classes, we assigned a specific biological growth function to each forest class in each global timber region. Accounting for geographic differences in local land use and scaling by the global 15-year average net primary production, we generate two maps of global timber production - (1) under current land uses and (2) under potential land use if non-forestry pixels were converted to forestry. For each pixel, we also estimate transportation costs using minute-to-market data. From this, we used Global Trade and Analysis Project (GTAP) data to subtract harvest and processing costs to get returns attributable to the land itself. This spatially explicit managed forestry production value can be used to understand land-use trade-offs and as input to land-use optimization and decision models.

Keywords: Managed forestry, Production value, spatial model, land-use



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Forest Ecosystem Services Valuation: A Choice Experiment Approach

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Department of Applied Economics, University of Minnesota

Natural Resources Research Institute, Department of Applied Economics, Department of Ecology, Evolution & Behavior, University of Minnesota

Abstract: Minnesota is home to more than 17 million acres of forested landscape. The forested landscape is owned by various state and federal agencies and private entities. Public and private landowners have different management objectives and use different management practices to pursue these objectives. Management practices impact timber volumes and value and also have impacts on critical ecosystem services. Understanding the value of ecosystem services is important for assessing the full benefits and costs of alternative forest management practices. This paper seeks to find the value of ecosystem services using a choice experiment. Not surprisingly, results show that survey respondents are in favor of increasing forest based goods and services: timber production, carbon sequestration, water quality, and habitat quality. However, their willingness to pay for these ecosystem services varies based on the levels of ecosystem services. We also found a considerable socio-demographic and spatial heterogeneity of willingness to pay for different ecosystem services. We find that households with pro-environmental views have significantly higher marginal willingness to pay for carbon sequestration and water quality. These results provide a better understanding in comparing among forest management practices that have varying degrees of impact on different ecosystem services.

Keywords: Forest Management, Ecosystem Services Valuation, Willingness to Pay (WTP), Choice Experiment



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May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Rancher's preference and willingness to pay for attributes and outcomes of non-traditional management practices: A best-worst choice experiment study

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Abstract: Amid changing climatic conditions, woody plant encroachment (WPE), wildland fire, and land-use changes such as limited use of fire, mono-species grazing, etc. are the major threats that circumscribe sustainable use of rangelands and the rangeland economy as a whole. Two non-traditional management practices, pyric herbivory, and mixed-species grazing have been identified as the best rangeland management practices. However the majority of the range landowners are yet to adopt the practices on their land. Since social acceptance towards a management practice may differ between individuals, investigation of individual landowners' preference for these best practices is inevitable. The present study, through the Best-Worst Choice (BWC) experiment, identified the best and the worst outcomes resulting from the non-traditional management practices, the impact of the attributes, and the outcome levels on the choice made by the landowners. Accordingly, the willingness to pay (WTP) for different outcomes are also estimated. The study results suggest that ensuring higher forage utilization, lower level of fire risk, wildlife promotion, and lower cost is likely to persuade landowners to conduct best management practices on their lands. Rangeland owners are willing to spend a significant additional amount of dollars on their land management costs if they can achieve desirable outcomes on their lands.

Keywords: woody plant encroachment, best rangeland management practices, Best-Worst Choice experiment, willingness-to-pay.



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Political Economy of Endangered Species Act Implementation—are Expenditure Decisions Political, Economic, or Ecological?

Sayeed R Mehmood

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Abstract: The Endangered Species Act (ESA) is a powerful legislation. When enacted in 1973, the Act had a high level of support and faced almost no opposition in Congress. Although the ESA is still going strong, it has faced significant opposition due to conflicts with different economic interests. Theories of public choice offer conceptual frameworks for analyzing decision making in the policy arena. This study analyzes federal funding for the ESA and seeks to identify the determinants. A variety of political, economic, and endangered species related variables are considered. Environmental voting record of legislative Natural Resource Committee Chairs has a significant influence on funding. While variables representing the health of the economy do have some influence, they are not always consistent. Number of listed species also has a significant effect. Funding patterns appear to vary by species groups and individual species.

Keywords: Endangered species; public choice; public policy



International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Economic Models for Optimal Plantation Establishment of Temperate Hardwoods

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Professor, Department of Forestry and Natural Resources, Purdue University

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Abstract: The success of hardwood tree plantings depends heavily on seedling survival and growth through the establishment period. Previous studies have empirically examined the causes of low establishment success, but treatment efficacy vis-a-vis relative costs remain unclear. We demonstrated with a multi-stage deterministic model that temperate hardwood species like black walnut and red oak were successfully established under herbicide use for first growing season combined with fencing for a 2400 trees per hectare planting and herbicide use for first three growing seasons with fencing for a 2400 trees per hectare planting respectively. The relative cost effectiveness - the impact of each treatment on increased survival and growth judged against its expense - at \$5.12 per surviving black walnut seedling and \$5.56 per surviving red oak seedling was the highest for a 3000 tree per hectare planting under herbicide use for first three growing seasons with fencing. Furthermore, introducing stochastic variability in modelled survival and diameter at breast height revealed higher density plantings proved risk mitigative to failure. The research links hardwood establishment success to a rigorous economic assessment of treatment efficacy and costs that can assist managers in decision making, while also informing policymakers about the effectiveness of current cost-share programs.

Keywords: Seedling establishment, Cost-effectiveness; Parameter Uncertainty, Hardwood management, Deer Fencing; Herbicide Control.



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

A network analysis approach for assessing the availability of resources and competition for it for Michigan's logging businesses*Shivan GC, Karen Potter-Witter, Larry Leafers, Raju Pokharel*

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Professor Emeritus, Department of Forestry, Michigan State University

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Assistant Professor, Department of Forestry, Michigan State University

Abstract:

In the wood products supply chain, the logging industry is a critical link that connects forest resources and the management of those forests with wood using mills. A healthy logging industry is, therefore, a prerequisite for sustainable forest management and for well-functioning forest products industry. This study conducts a network analysis using the location of 115 logging businesses in Michigan along with the road dataset for the state and information collected from mail survey of logging businesses to evaluate areas that have high competition for resources versus those that do not. It further utilizes forest ownership dataset for the state to understand the reliance of logging businesses on different forest ownership types in Michigan. Approximately sixteen percent of the total forest acres available in the procurement area of 115 logging businesses have relatively less competition (with 5 or less logging businesses competing for the same resource), while three percent have very high competition (with 20 or more logging businesses competing for the same resource). Such information can be useful for making decisions regarding the location of new logging facilities within the state and for understanding business environment for those that are already in business. Besides that, information about the reliance of existing logging businesses on different forest ownership types is crucial for understating how changes in logging businesses may impact the management of forest resources owned by different forest ownership types and vice versa within the state.

Keywords: logging, survey

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May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Integration of Public Farmland and Timberland REITs with their Private Equity Counterparties and Selected Asset Classes

Srijana Baral, Bin Mei

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Professor, Warnell School of Forestry and Natural Resources, University of Georgia

Abstract: Purpose- The purpose of this study is to examine the return sensitivity of public farmland and timberland real estate investment trusts (REITs) to private-equity farmland, timberland, and real estate, long-term corporate bonds, and large- and small-cap stocks. We also examine time-dependent contributions of selected asset classes to farmland and timberland REIT volatility.

Design/methodology/approach- We use a multi-factor asset pricing model under a seemingly unrelated regression framework to evaluate farmland and timberland REIT returns, and a state-space model with the Kalman filter to evaluate the time-dependent contributors of farmland and timberland REIT volatility. We first perform orthogonalized regressions to obtain pure independent factors, and then decompose volatility into individual asset components.

Findings- Significant loadings on financial assets are found for both farmland and timberland REITs, suggesting that they are generally driven by some common state variables. Large-cap stocks are found to be the major contributor of farmland and timberland REIT volatility, despite some differing patterns over time.

Originality- Empirical analysis of farmland REIT is very scarce. We compare the risk-return characteristics of farmland and timberland REITs under a state-space framework with the Kalman filter. This study can improve our understanding of the roles of farmland and timberland REITs in a multi-asset portfolio.

Keywords: Alternative assets, Farmland investment, Real estate, Timberland investment, Volatility decomposition



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New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Evaluating the Impacts of the COVID-19 Pandemic on Forest-based Employment in the U.S. South

Stephanie Chizmar, Rajan Parajuli, Erin Sills

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Professor and Department Head, Department of Forestry and Environmental Resources, North Carolina State University

Abstract: The United States (U.S.) South, 13 southeastern states from Virginia to Texas, features approximately 245 million acres of forestland, encompassing about 46% of the total land use, and produces more timber than any other single country in the world. As such, the forest sector in this region is a vital economic engine, particularly in the rural regional economy. While the coronavirus disease of 2019 (COVID-19) caused by the virus SARS-CoV-2 has disrupted the entire world economy across the board, forestry in the U.S. was categorized as an “essential industry” to ensure the supply of vital forest-based products during the early lockdown weeks in 2020. Consequently, this leads to research questions related to the impacts of the Pandemic, its associated mitigation strategies, and the formal designation of being an “essential industry” on employment trends. The overall goal of this study is to examine the impacts of the Pandemic on forest-based employment in the U.S. South. In order to quantify these impacts, we employ a two-way fixed effects estimation approach in a panel data setting of county-level employment and other related statistics. The findings from this study will provide insights on the impacts of pandemic-related disasters as well as strategies to revive the forest-based rural economy in the southern states.

Keywords: forest sector; coronavirus disease of 2019; causal inference; two-way fixed effects; post-pandemic recovery



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2022 ISFRE Meeting

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New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

A stand level growth and yield model for oak-gum-cypress forest type in southern bottomlands

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Assistant Professor, Department of Forestry, Mississippi State University

Abstract: Need for a growth and yield modeling tool for the productive southern bottomland hardwood (BLH) sites was the basis for this study. Oak-gum-cypress forest yield was studied throughout the bottomlands of the Gulf Coast region. Data for model development was obtained from the USDA Forest Service's Forest Inventory and Analysis (FIA) database. A compatible whole stand growth and yield model for cubic feet growing stock volume (GSV) and board feet sawlog volume (SLV) were developed using fuzzy linear regression. Site index, basal area and stand age were the independent variable to describe the present and future stand conditions. The study included total of 526 plots with mean GSV of 2,555.61 cubic feet and mean SLV of 11,182.64 board feet. Fuzzy regression resulted with coefficient of determination 0.96 for GSV and 0.89 for SLV. Mean absolute percent error in the validation set was 9.36 % and 41.96 % for GSV and SLV respectively. The study will further include whole stand growth and yield model for forest carbon to better understand the carbon sequestration potential of these forest type in the context of increasing interest in carbon payments for the forest landowners. The developed model is expected to operate realistically across a wide range of BLH sites and stand conditions, be relevant, simple to use and easily accessible for all.

Keywords: whole stand, growth and yield, bottomland, fuzzy, carbon



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2022 ISFRE Meeting

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New Opportunities and Challenges in Forest Resource Economics
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Abstract: Oral Presentations

Real options, timber insurance, and the generalized Faustmann formula under risk and uncertainty

Sun Joseph Chang

Professor, Louisiana State University

Abstract: Timber production is a risky business, with both price uncertainties resulting from fluctuations of stumpage prices and volume risk resulting from natural and man-made disasters. Past studies of reservation prices have been shown to be the equivalent of a real option. Harvesting decisions based on the reservation price produce results which are financially superior to that of decisions made under the assumption of certainty. Real options, however, are only meaningful if it can be delivered when called upon. When disasters strike, the underlying asset is destroyed and can no longer be delivered, thus making the real option irrelevant. In this paper, we will show that the price uncertainties can be managed with a real option while the volume risks can be addressed through timber insurance. Under such arrangement, forest management once again becomes a decision-making process under a certainty equivalent environment.

Keywords: Generalized Faustmann formula, risk and uncertainty, timber management, reservation price



International Society of Forest Resource Economics (ISFRE)

2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Oral Presentations

Factor endowment and structural change in Kentucky forest industry

Thomas O. Ochuodho, Domena A. Agyeman

Assistant Professor, Department of Forestry and Natural Resources, University of Kentucky
Postdoctoral Associate, Virginia Tech

Abstract: Factor endowment-based structural change theorems posit that increase in factor endowment of a region leads to an increase in output of the industries that use the factors more intensively. This study uses a dynamic panel regression analysis to examine the linkage between factor endowment and structural changes in Kentucky forest industry. The analysis uses forest-based industries' shares in employment and real output as structural variables in the regressions. Results show that increase in both capital and labor endowments have a positive and significant influence on forest industry structure as the industry uses the respective factors intensively. Moreover, the magnitude of the influence of labor endowment is higher than that of capital endowment. Further, results show that final demand has a marginal positive influence on Kentucky forest industry structure. Results are useful for recommending policy options to improve and sustain Kentucky's forest industry.

Keywords: Factor endowment, Structural Change, Forest Industry, Kentucky



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New Opportunities and Challenges in Forest Resource Economics
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Abstract: Oral Presentations

The Informal Economy of Wiregrass Production for Longleaf Pine Restoration

Tyler Carney, Damian Adams

Graduate Student, School of Forest, Fisheries, and Geomatics Sciences, University of Florida

Professor, School of Forest, Fisheries, and Geomatics Sciences, University of Florida

Abstract: Wiregrass (*Aristida behrichiana/stricta*) is an understory grass often used to restore the ecosystem health, function, and biodiversity of longleaf pine (LLP; *Pinus palustris*) ecosystems. It is frequently the primary species seeded into restoration projects because it is known to carry the frequent, low intensity fires essential for maintaining open canopy savannas. A limitation to restoration of LLP savannas is the availability of a sufficient amount of viable wiregrass seed or plugs. Here, we examine qualitative data (interviews) to identify and contextualize the economic, logistical, and ecological barriers to the availability of wiregrass for restoration. We conducted semi-structured interviews of private landowners, public land managers, and conservation organization staff members. Using a qualitative data analysis approach (88% inter-coder reliability), we identified eight emergent themes 1) knowledge barriers must be overcome for restoration success, 2) restoration can be cost prohibitive, 3) site preparation is a major challenge, 4) fire is the dominant and most cost effective management method, 5) bartering and/or collaboration promotes restoration success, 6) a closed-loop/in-house management system is ideal, 7) changing weather conditions influences restoration success, and 8) restored ecosystems have intrinsic and other nonmarket values. These findings should help landowners and land managers address and overcome restoration challenges in LLP ecosystems and inform policy decisions and program design to promote successful LLP restoration.

Keywords: ecosystem restoration, conservation, fire, challenges, values, collaboration



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New Opportunities and Challenges in Forest Resource Economics
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Abstract: Poster Presentations

The Economic Value of Prescribed Burning in Northeastern Forests

Arun Regmi

Graduate Student, Penn State University

Abstract: Prescribed fire has the potential to offer cultural and ecological benefits, and help build resilience under climate change, however, research examining the value of prescribe fire has largely focused on the benefits of reduced wildfire hazard. Both wildfire and prescribed fire occur infrequently in northeastern regions of the United States, however, there is increased interest in using prescribed fire as a forest management tool. To understand the value of prescribed burning in this region we assessed forest owner willingness to pay (WTP) for diverse categories of prescribed fire benefits and programs using Likert scales and choice experiment questions. Preliminary results indicate most forest owners have low knowledge of prescribed fire, but in some states there is also low perceptions of risk and high trust in prescribe fire implementers. Mean WTP was frequently positive and varied across states and categories of forest owners. Many respondents preferred programs that helped maintain ecosystem health and biodiversity, reduced nuisance wildlife and offered landowner assistance. We conclude demand for prescribed fire can be significant when it helps owners obtain important ecological and cultural benefits. Education and technical support will be important for expanding the prescribed fire economy in this region. The findings may help to make effective strategies to support private land burning in this region.

Keywords: Prescribed fire, willingness to pay, choice experiment, private landowners



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New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Poster Presentations

Willingness to Harvest in the Lake State Region

Kyle MacLean, Andy Finley, Raju Pokharel

Graduate Student, Department of Forestry, Michigan State University

Professor, Department of Forestry, Michigan State University

Assistant Professor, Department of Forestry, Michigan State University

Abstract: Understanding timberland owner's decision-making about when to harvest informs our ability to estimate changes in the timber supply resulting from changes in factors that are significant for landowners. This study proposes a model for landowner willingness to harvest in the Lake State region. Bi-annual stumpage price from 2012 to 2021, and USFS FIA inventory data is used to drive the model. Timber harvest choices are estimated as a probit probability model. Statistical significance of timber supply elasticity with respect to product prices is estimated. Results are useful for researchers, industry, or state officials planning to implement programs that affect timber product prices. Some examples include introduction of new processing facilities or carbon retention subsidies.

Keywords: modeling, harvest choice modeling, probit model, lake states, timber, prices



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2022 ISFRE Meeting

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New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Poster Presentations

Identifying locations for biochar production from low-value biomass in Michigan

Nafisa Nowshin Ahmed, Raju Pokharel, Christopher Saffron, Jessica Miesel

Graduate Student, Department of Forestry,
Michigan State University

Assistant Professor, Department of Forestry,
Michigan State University

Associate Professor, Department of Biosystems and Agricultural Engineering, Michigan State University
Associate Professor, Department of Plant, Soil and Microbial Sciences, Michigan State University

Abstract: Biochar is a form of carbon that is produced using slow pyrolysis and is known to have great carbon sequestration ability. Our research aims to conduct a forest product market analysis in Michigan to locate hotspots to place new facilities for producing biochar using low-value biomass. About 53% of Michigan is forested lands, which is facing an issue of utilizing low-value wood products and logging residues and increasing the risk of pathogen outbreaks and fire. This study is designed to improve the utilization of such wood products to produce biochar at optimally placed locations by identifying hotspots of biomass availability (feedstock) and competition from existing biomass users. To accomplish this, we overlay competition hotspots maps, resource availability maps, and other qualitative information to identify the cost-optimal locations for new facilities. Then we estimated the available feedstock drawing procurement zones around these facilities with current delivered wood prices and inventory data from the FIA database. After an initial qualitative assessment of biomass availability from forests, primary and secondary mills, Marquette and Grand Traverse in Michigan could be optimal locations for establishing new biochar facilities. The outcome of this study will bridge the knowledge gap on biochar production and commercialization, connecting landowners, foresters, and policymakers toward developing policies on biomass and biochar. We hope that this analysis will encourage stakeholders to consider bio-products such as biochar and the contribution of resource utilization-based solutions in building a circular bioeconomy.

Keywords: logging residues, competition hotspot maps, procurement zones



2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management**Abstract: Poster Presentations****Identifying hotspots to establish mass timber processing facilities and their impacts on the local economy in Michigan***Naresh Khanal, Raju Pokharel, Emily Huff, Jagdish Poudel, Andy Finley*

Graduate Student , Department of Forestry, Michigan State University

Assistant Professor, Department of Forestry, Michigan State University

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Forest Economist, Forest Resource Division, Michigan Department of Natural Resources

Abstract: Mass timber is an engineered wood product offering a viable alternative for steel and concrete structures which is known to produce significant GHGs emissions. Mass timber is environmentally sustainable, renewable, and has better engineering properties like strength, durability, and consistency. Mass timber is an umbrella term used for various products such as Cross Laminated Timber, Glue Laminated Timber, Laminated Veneer Lumber, and Nail Laminated Timber. The major objective of this study is to identify economically feasible supply regions and market extents for mass timber in Michigan. This study aims to identify optimal locations for mass timber processing facilities. Using road networks and locations of milling facilities in Michigan, I run network analysis in ArcGIS to generate the procurement zones around each facilities that utilize softwood sawtimber. These zones represent the economically feasible regions to haul timber. I then overlay these procurement zones to create coverage and competition hotspots for softwood utilizers. Finally, the coverage and competition maps are overlaid with forest ownership maps. This would allow me to identify hotspots areas where establishing the mass timber production facilities will be justified. In addition, I will conduct an economic impact assessment of mass timber facilities using IMPLAN. For accomplishing the goal of sustainable forest management and encouraging mass timber over its counterparts, forest managers, landowners, and policymakers need to understand the market coverage and competitiveness of softwood sawtimber. The findings will be helpful for the policy-makers, business owners, and consumers in making evidence-based choices/decisions regarding mass timber facilities in Michigan.

Keywords: CLT, merchantability, network analysis, procurement zones, forest products



2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management**Abstract: Poster Presentations****Two birds with a stone? The Rural Environmental Registry (CAR) and Its Potential Spillover Effects Over Land Conflicts in the Brazilian Amazon***Nilesh Nivrutti Shinde*

Ph.D. Candidate, Department of Forest Resources and Environmental Conservation, Virginia Tech

Abstract: Insecure property rights emerging from ill-defined laws and burdensome bureaucracy conform to a common institutional picture across the developing world, often leading to a fault line that commences with land speculation and is followed by social conflict over land ownership and deforestation. We assess the effects of a one-of-a-kind environmental management policy established to halt deforestation – the rural environmental registry (CAR for the Portuguese acronym "Cadastral Ambiental Rural") – on conflicts over land in the Brazilian Amazon, a unique case study of insecure property rights to land conflict, and deforestation in the literature. The CAR is mandatory for all private rural properties and does not require a formal title to the land. However, there was anticipation among titleless landholders that enrollment in the CAR would allow them to declare ownership over the land and a fast track to a formal legal title—the Forest Code of 2012 consolidated previous state-level registration programs of Mato Grosso and Pará. In our analysis, the difference in timing of program implementation in Pará (in 2008) and Mato Grosso (in 2009) in relation to the rest of the Brazilian Amazon (in 2012) allows us to model the CAR as a staggered treatment intervention. We find land conflicts increased in post-intervention periods in the Brazilian Amazon in general. Using staggered DiD, we find that Para (treatment cohort-2008) has experienced a statistically significant reduction in a land conflict with the ATT-by-group showing a 0.512-unit reduction in land conflicts. In contrast, Mato Grosso (treatment cohort-2008) significantly increases conflicts in the ATT-by-group with 0.482 units. The rest of the states in the Amazon (treatment cohort-2012) also experienced a significant increase in land conflicts by the ATT-by-group: 0.281units. Thus, our results suggest that the staggered implementation of the Forest Code through the CAR program had unique consequences over land conflict across different groups and years since CAR. Finally, we found a dynamic event study design that increased land conflicts significantly across all groups. We find evidence that early treated groups like Para experienced decreased conflicts while the rest of the Brazilian Amazon states experienced an increase. We suggest that the long-term implementation of CAR has persistent unintended consequences in terms of increasing land conflicts across the newer development frontier of Amazon. This may indicate recurring extensions within 2012 Forest Code registration deadlines.

Keywords: Brazil, Forest Code 2012, land conflicts and Difference-in-Difference

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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Poster Presentations

Uneven Forest Management Principles and Urban Ecosystem Services Supply

Robert Jarred Sparks, Puskar Khanal

Graduate Student, Department of Forestry & Environment Conservation, Clemson University
Assistant Professor, Department of Forestry & Environment Conservation, Clemson University

Abstract: Sustainable urban forest management is still an evolving concept, particularly regarding climate change resiliency and optimal supply of ecosystem services. Urban trees have stronger social-economic and environmental components than wood or products supply focus in traditional timber-focused forestry practices. Urban forest management goals primarily focus more on regulating, cultural, and supporting services. Recent urban forestry studies evaluating ecosystem benefits have focused mainly on tree frequency and species diversity and their relationship with the benefits. Likewise, SFI Inc. has recently developed a sustainable urban forest management standard for urban forest certification in the United States. Few studies have evaluated whether classical uneven forest management principles could be adopted to manage urban forests and ensure a sustainable supply of ecosystem services. This study assessed the potential application of the target diameter distribution approach, Q-factor, in managing Clemson University urban forest. The i-Tree Eco model was used to estimate total ecosystem services (carbon, pollution removal, and run-off reduction) using total inventory and local weather pollution data. Interestingly, Clemson's urban forest structure closely resembled the targeted diameter distribution under the Q-factor approach, but the total ecosystem services supply was less than optimal. It suggests that classical forest management strategies could be potentially helpful in regulating urban forests, but recently developed optimization approaches could be more useful for spatial and dynamic planning.

Keywords: Ecosystem services, forest management, forest carbon, economic valuation



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New Opportunities and Challenges in Forest Resource Economics
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Abstract: Poster Presentations

Timber Supply Analysis in Arkansas: A Case Study from Magnolia City, Arkansas

Sagar Godar Chhetri, Matthew Pelkki

Post-Doctoral Research Associate, Arkansas Center for Forest Business, University of Arkansas at
Monticello, Arkansas

Director & Professor, Arkansas Center for Forest Business, College of Forestry, Agriculture & Natural
Resources, University of Arkansas at Monticello

Abstract: Arkansas has more than 18.88 million acres (57% of the total area) of forestland. About 80% of those forestlands are owned by private forest landowners. Every year, private forest landowners supply forest products to the forest-based industry. However, the information regarding the existing timberland condition in Arkansas is still unknown. The objective of this study is to quantify the growing stock, annual net growth, and annual removal and surplus for the forest products such as saw timber, pulpwood, and top wood. The United States Department of Agriculture (USDA) Forest Inventory and Analysis (FIA) database is the source of the data of the study. We used online software EVALIDATOR and DATIM to carry out the study. The results are presented on the basis of within 70 and 100 miles aerial radius of Magnolia city, Arkansas. We found that the majority (63%) of the forestlands are naturally regenerated and 92% are owned by private forest landowners in Magnolia, Arkansas. Also, there are 7.3 and 14.4 million acres of timberland within 70 and 100 miles, respectively. Since pine (52%) is the dominant forest type in the study area, pine growing stock is higher than hardwood growing stock. In addition, net timber growth exceeds harvests by more than 50% annually. Thus, Magnolia City can sustain a few more timber industries in order to utilize the surplus forest products, which ultimately meet the growing demand for timber products and could provide a contribution to the local, regional, and national economy.

Keywords: Timberland, FIA, growing stock, annual net growth, annual removal and surplus



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New Opportunities and Challenges in Forest Resource Economics
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Abstract: Poster Presentations

Economic Models for Optimal Plantation Establishment of Temperate Hardwoods

Sayon Ghosh, Doug Jacobs, Mike Saunders, Mo Zhou

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Professor, Department of Forestry and Natural Resources, Purdue University

Associate Professor, Department of Forestry and Natural Resources, Purdue University

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Abstract: The success of hardwood tree plantings depends heavily on seedling survival and growth through the establishment period. Previous studies have empirically examined the causes of low establishment success, but treatment efficacy vis-a-vis relative costs remain unclear. We demonstrated with a multi-stage deterministic model that temperate hardwood species like black walnut and red oak were successfully established under herbicide use for first growing season combined with fencing for a 2400 trees per hectare planting and herbicide use for first three growing seasons with fencing for a 2400 trees per hectare planting respectively. The relative cost effectiveness - the impact of each treatment on increased survival and growth judged against its expense - at \$5.12 per surviving black walnut seedling and \$5.56 per surviving red oak seedling was the highest for a 3000 tree per hectare planting under herbicide use for first three growing seasons with fencing. Furthermore, introducing stochastic variability in modelled survival and diameter at breast height revealed higher density plantings proved risk mitigative to failure. The research links hardwood establishment success to a rigorous economic assessment of treatment efficacy and costs that can assist managers in decision making, while also informing policymakers about the effectiveness of current cost-share programs.

Keywords: Seedling establishment, Cost-effectiveness; Parameter Uncertainty, Hardwood management, Deer Fencing; Herbicide Control.



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2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Poster Presentations

Optimal Rotation Age with Stochastic Input Distribution

Shaun M. Tanger, Bruno Kanieski da Silva, Jesse D. Henderson

Assistant Professor, Coastal Research and Extension Center, Mississippi State University

Assistant Professor, Department of Forestry, Mississippi State University

Research Economist, Forest Economics and Policy, USDA Forest Service

Abstract: Forest landowners are often advised to make deterministic management decisions with respect to their forest property (implicitly and explicitly) given inputs for costs, revenues, discount rates, and growth and yield results. Of particular interest is the decision of when to conduct a final harvest. While use of the Faustmann formula provides an idealized optimal rotation age, it assumes fixed inputs. These fixed inputs can vary greatly on a single property and from one landowner to another due to a combination of factors. In short, if factors vary greatly, the decision of when to harvest will vary as well.

Utilizing simulated data, and assuming ranges of the previously mentioned inputs, we allow for fluctuations in these inputs to provide a distribution of outcomes for thinning and final harvest decision-making. Random selection of combinations of these inputs can provide forest managers with expectations for the range of possibilities ex-ante. Therefore, the model can be used by managers to input historical or hypothetical data specific to their circumstances and provide a more flexible range of final harvest decisions. Further, the probabilities can be used to create profiles of a range of landowner's harvest behavior to examine landscape scale patterns that emerge.

Keywords: stochastic distribution, optimal rotation, PTEADA, simulation



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2022 ISFRE Meeting

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New Opportunities and Challenges in Forest Resource Economics
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Abstract: Poster Presentations

The Time-Varying Link of Public Timber REITs with Private Timberland, Real Estate, and Financial Assets

Srijana Baral, Bin Mei

PhD Candidate, Warnell School of Forestry and Natural Resources, University of Georgia
Professor, Warnell School of Forestry and Natural Resources, University of Georgia

Abstract: We examine the relationship between public timber real estate investment trust (REIT), private timberland, real estate, and financial asset returns using a multi-factor model and investigate the time-varying volatility of timber REITs under the state space framework. We first orthogonalize explanatory variables to obtain pure factors. Then, we decompose REIT volatility into S&P500, private-equity timberland, real estate, bond, and idiosyncratic risk components. Results reveal that timber REITs are positively sensitive to S&P500 and bonds. Volatility contribution of S&P500 is consistent and high whereas that of idiosyncratic risk declines over time. Other factors, private-equity timberland, real estate, and bond, exhibit negligible contribution to the volatility of timber REITs. We conclude that timber REIT characteristics change with time and timber REIT market is not mature.

Keywords: Kalman filter, timberland investment, time series, volatility decomposition



2022 ISFRE Meeting

May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management**Abstract: Poster Presentations****Optimal Routing for Softwood Sawmill Supply Chain: Strategic Repair of Road and Bridge Infrastructure***Swagat Attreya, Shaun M. Tanger, Eric McConnell, Michael Crosby*

Graduate Student, Department of Forestry, Mississippi State University

Assistant Professor, Department of Forestry, Mississippi State University

Assistant Professor, Department of Forestry, Mississippi State University

Assistant Professor, School of Agricultural Sciences and Forestry, Louisiana Tech University

Abstract: Haulage costs account for about one-third to 50% of logging operations costs of the forest industry, depending on its type and location. Sawmills prioritize raw materials' availability/accessibility and associated transportation costs as the major costs to determine their financial viability. As Mississippi has a plentiful timber resource to supply sawmills, improving the transportation system to reduce transportation costs is crucial to attract new sawmills. This research aims to create an ideal transport network system for all of the softwood sawmills in Mississippi. It also determines the repair of which bridges and roads are most economically efficient for repair. The required roads and bridges datasets, and their condition information will be collected from the U.S. Department of Transportation (USDOT), and USGS National Transportation Dataset (NTD) website. Similarly, Sawmill's GPS location will be collected and the harvest site's location will be extracted from Forest Inventory and Analysis National Program (FIA) database. The transportation network system will be created using ArcGIS to determine the optimal routes for the respective sawmills. Then, the most efficient routes will be determined, and the economic impacts of these transportation network improvements on the state economy will be examined. This research will aid in improving the efficiency of the sawmilling supply chain and examining the economic impacts improvements will make on sawmills and Mississippi.

Keywords: Network System, Supply chain



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May 23-25, 2022, Traverse City, Michigan

New Opportunities and Challenges in Forest Resource Economics
for Forest Products, Ecosystem, and Carbon Management

Abstract: Poster Presentations

The logging sector in East Texas

Thomas Frampton, Anusha Shrestha

Undergraduate Research Assistant, Department of Forestry, Arthur Temple College of Forestry and
Agriculture, Stephen F. Austin State University

Assistant Professor, Department of Forestry, Stephen F. Austin State University

Abstract: The logging sector is a crucial component of the forest products industry in East Texas. It connects forest resources with mills, who subsequently use that wood to manufacture a multitude of products to meet demands from the entire state. An improved understanding about the state of logging businesses among legislators, foresters, industry, and the public is critical to aid in sustaining this sector. Therefore, the objective of this study is to determine the status and future outlook of the logging sector in East Texas. A mixed method using both online surveys and mail surveys will be used to collect data from logging businesses. Descriptive as well as predictive analyses will be done to summarize the survey data. Furthermore, the study aims to estimate the economic contribution of the logging sector in the rural communities in East Texas and assess COVID-19 pandemic effects. Impact Analysis for Planning (IMPLAN) data will be used. The economic contribution of the logging sector in 2019, 2020, and 2021 will be estimated and compared. The study results will be helpful in formulating programs and policies to enhance logging sector and hence, ensure continued supply of wood products to the mills, protection of forest health, and economic contribution in rural communities.

Keywords: Logger survey, Logging sector challenges, Logging sector opportunities, Rural development



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Tour

Tour of northern hardwood sawmill and northern hardwood forest

Destination: **Housler's Sawmill in Mesick, Michigan**

Michigan State University and the Michigan Department of Natural Resources offer a field tour option to visit a northern hardwood sawmill and northern hardwood forest field site visit. This optional tour will utilize a group bus for transportation to Housler's Sawmill in Mesick, Michigan. Participants will need to be able to handle short flights of stairs and willing to wear hardhats, safety glasses, and earplugs for the sawmill portion of the afternoon. These items will be provided to each participant for the tour.

Housler Sawmill is a family-owned and operated hardwood mill that is the epitome of Michigan's forest products industry. They have their own logging crews to supply the mill along with purchasing logs from other wood producers. They are trained and certified by Michigan's Sustainable Forestry Initiative and a member of the Michigan Association of Timbermen-Self Insurers' Fund to maintain a high level of responsibility and safety in all aspects of their business operations. Mill owners will be assisting in the tour and will be available for your questions.

After departing the sawmill, the bus will make a 60-minute stop on the return route to Traverse City to a quality northern hardwood forest stand. This field stop is designed to have an interactive and energetic discussion around the economic importance and variability of the hardwood industry in Michigan and the Upper Great Lakes region. We hope you can join us for this afternoon adventure outside the conference room.

Time and stop for the tour.

- 2:00 PM Depart from Hotel (Traverse City)
- 2:30 PM Arrive at Housler Sawmill, Mesick MI
- 2:30-4:00PM: Tour of hardwood sawmill, log receiving yard, finished product shipping yard (Discussion will be around species use, methods of wood utilization, and market conditions for hardwood lumber products.)
- 4:00 PM: Depart sawmill for hardwood forest site visit
- 4:15-5:00 PM : Forest Field stop to discuss economics of hardwood forest management in Michigan
- 5:30: Arrival to Hotel (Traverse City)

This tour is made possible by -



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