Abstracts

2026 ISFRE and WFE Joint Meeting

Emerging Risks and Shifting Market Challenges: Identifying Pathways and Solutions for a Resilient Forest Future

May 18-20, 2026, Fort Collins, Colorado

International Society of Forest Resource Economics (ISFRE)
Western Forest Economist (WFE)

Meeting Info: https://msuferm.com/isfre26/

FOREST AND RANGELAND STEWARDSHIP
COLORADO STATE UNIVERSITY

Department of Forestry
MICHIGAN STATE UNIVERSITY

2026 ISFRE and WFE Joint Meeting

Emerging Risks and Shifting Market Challenges: Identifying Pathways and Solutions for a Resilient Forest Future

May 18-20, 2026, Fort Collins, Colorado

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Schedule at a glance

Time	Room	Activity and Sessions		
Monday, May 18, 2026 (Arrival Day)				
1:00 - 5:00 PM	Hotel Lobby	Tour (Biochar Now, *19500 County Road 7, Berthoud, CO 80513*)		
5:30 - 6:30 PM	Hotel Atrium	Reception and Networking, Poster Setup in Salon II & III		
6:30 - 8:00 PM	Salon I & V	Dinner Banquet		
Tuesday, May 19, 2026 (Day 1)				
7:00 - 8:00 AM	Salon II & III	Breakfast and Poster Setup. Food station in the Atrium		
8:00 - 8:15 AM	Salon II & III	Opening Remarks: Dr. Eric Toman, Department Head of Forest & Rangeland Stewardship		
8:15 - 9:00 AM	Salon II & III	Keynote Speech: Dan Gibbs		
9:00 - 10:00 AM	Salon II & III	Panel 1: Emerging and New Markets for Forest Products and Shifting Market Risks and Challenges (Moderator: *Raju Pokharel*; Panelist: ***Daowei Zhang, Jesse Henderson, Greg Latta***)		
10:00 - 10:30 AM	Salon II & III	Networking Break and **Poster Session 1**		
CONCURRENT SESSIONS		**Salon I**	**Salon II & III**	**Salon IV**
10:30 - 12:00 PM		Session: 1. Forest Product Markets: Price Dynamics, Policy Impacts, and Market Behavior	Session: 2. Forest Product Industry Structure and Mill Dynamics	Session: 3. Economic Impacts of Natural Disturbances
12:00 - 1:00 PM	Salon II & III	Lunch. Food station in the Atrium		
CONCURRENT SESSIONS		**Salon I**	**Salon II & III**	**Salon IV**
1:00 - 2:30 PM		Session: 4. From Stand Dynamics to Decision Support: Innovations in Forest Management	Session: 5. Environmental & Economic Tradeoffs	Session: 6. Forest-Based Climate Mitigation
2:30-3:00 PM	Salon II & III	Networking Break and **Poster Session 2**		
CONCURRENT SESSIONS		**Salon I**	**Salon II & III**	**Salon IV**
3:00 - 4:30 PM		Session: 7. Economic and Social Dimensions of Wildfire Management	Session: 8. Lightning Session (7 minutes)	Session: 9. Private Forest Landowners: Behavior, Adoption, and Policy Engagement
5:00 PM		Dinner (on your own)		

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Schedule at a glance

Time	Room	Activity and Sessions		
Wednesday, May 20, 2026 (Day 2)				
6:00-7:30 AM: Wellness Activity (Hiking and sightseeing at the Horsetooth Reservoir); Meet at hotel lobby and carpool				
7:30 – 9:00 AM	Salon II & III	Breakfast and Business Meeting. Food station in the Atrium		
9:00 - 10:00 AM	Salon II & III	Panel 2: Innovative Financing Mechanisms of US Forestry Projects: Trends and Future Implications (Moderator: *Shivan Gc*; Panelist: ***Richard Mei, Anil Koirala, Phil Saksa***)		
10:00 - 10:30 AM	Salon II & III	Networking Break and **Poster Session 3**		
CONCURRENT SESSIONS		**Salon I**	**Salon II & III**	**Salon IV**
10:30 - 12:00 PM		Session: 10. Trade Policy and International Forest Product Markets	Session: 11. From Policy to Practice: Conservation Outcomes and Stakeholder Responses	Session: 12. Ecosystem Services, Conservation Finance, and Stakeholder Engagement
12:00 - 1:00 PM	Salon II & III	Lunch. Food station in the Atrium		
CONCURRENT SESSIONS		**Salon I**	**Salon II & III**	**Salon IV**
1:00 - 2:30 PM		Session: 13. Forest Biomass and Bioenergy Markets	Session: 14. Wildfire Prevention, Mitigation, and Socioeconomic Consequences	Session: 15. Forest Management and Silviculture Economics
2:30-3:00 PM	Salon II & III	Networking Break and **Poster Session 4**		
CONCURRENT SESSIONS		**Salon I**	**Salon II & III**	**Salon IV**
3:00 - 4:30 PM		Session: 16. Wood Supply Optimization, and Life Cycle Impacts	Session: 17. Spatially explicit data, modeling, and decision-support tools	Session: 18. Integrating Economics, Ecology, and Climate in Forest Management
4:30- 5:00 PM	Salon II & III	Closing and Awards		
5:00 PM		Dinner (on your own)		
Thursday, May 21, 2026 (Departure Day)				

Contents

Outdoor events

Facility Tour

Monday, May 18, 2026, 1:00 PM – 5:00 PM

Facility: **BioChar Now**

Location: *19500 County Road 7, Berthoud, CO 80513*

Please schedule hotel arrival by 12:30 for the field tour. Alternatively, you can stop at the site before checking in at the hotel, since it's on the way to Fort Collins from the airport.

Meet at the hotel lobby at 1 pm to be picked up by a tour bus. The drive will be ~35 mins to the site. Box lunch will be provided to the tour participants. The bus will drop everyone off at the hotel by 5 pm. Reception starts at 5 pm.

Wellness Activity

Wednesday, May 20, 2026, 6:00 AM -7:30 AM

Wellness Activity: Hiking and sightseeing at the Horsetooth Reservoir

Meet at the hotel lobby and carpool (Transportation is not provided)

May 19: 8:15 am – 9:00 am (Salon II & III)

Session: Keynote by Dan Gibbs

Dan Gibbs is the Executive Director of the Colorado Department of Natural Resources. As the director, Dan leads the development and execution of the Department's initiatives to balance the management of the state's natural resources. Prior to joining the Department of Natural Resources, Dan served as a Summit County Commissioner from 2010-2018. Prior to his tenure as a Commissioner, Dan served in the Colorado House of Representatives and in the Colorado State Senate, where he served on the Senate Agriculture and Natural Resources Committee.

His legislative accomplishments include securing funding for wildfire mitigation and forest health, creating the Colorado Kids Outdoors grant program, supporting watershed health initiatives, and increasing environmental protections for wildlife from oil and gas development. Dan is a certified wildland firefighter and chaired the statewide Wildland Fire and Prescribed Fire Matters Advisory Council, and represented county governments on the Forest Health Advisory Committee. Dan is a graduate of Western State Colorado University and completed the Harvard Kennedy School Senior Executives in State and Local Government Program. Learn more about Dan and CO DNR here: https://dnr.colorado.gov/contacts/dan-gibbs

May 19: 9:00 am – 10:00 am (Salon II & III)

Session: Panel 1- Emerging and New Markets for Forest Products and Shifting Market Risks and Challenges

Moderator: ***Raju Pokharel***, Michigan State University

Panelists:

Daowei Zhang | Auburn University

Dr. Zhang is Alumni and George W. Peake Professor of forest economics at Auburn University. He is an expert in the areas of forest management, trade, investment and finance, economic development, and international forestry. Learn more about Dr. Zhang here: https://cfwe.auburn.edu/profile/daowei-zhang/

Jesse Henderson | US Forest Service

Dr. Henderson is a Project Leader and Research Economist at the Southern Research Station. Dr. Henderson's expertise lies in the economics of human and natural disturbances (hurricanes, wildfires), timber sales in the National Forests, carbon markets, forest product mills, the forest sector, and agent-based models. Learn more about Dr. Henderson here: https://research.fs.usda.gov/about/people/jesse.henderson2

Greg Latta | University of Idaho

Dr. Latta is Associate Professor of forest economics and Director of the Policy Analysis Group at the University of Idaho. His work focuses on simulating policy impacts on markets using mathematical optimization techniques. He has been involved in the voluntary forest carbon offset space for well over a decade and has participated in crafting multiple methodologies as well as offset project development work. Learn more about Dr. Latta here: https://www.uidaho.edu/people/glatta

May 20: 9:00 am – 10:00 am (Salon II & III)

Session: Panel 2 - Innovative Financing Mechanisms of US Forestry Projects: Trends and Future Implications

Moderator: ***Shivan GC***, Michigan State University

Panelists:

Richard Mei | Duke University

Dr. Mei is Professor of Practice and Director of the Natural Resources Finance Initiative. His research program centers on forestland investment, nature-based climate solutions, and decision-making under uncertainty. Learn more about Dr. Mei here: https://nicholas.duke.edu/people/faculty/mei

Anil Koirala | Compeer Financial

Dr. Koirala is the Vice President of Sustainability and Carbon Markets at Compeer Financial, where he leads carbon project financing and develops innovative sustainable finance products. He supports underwriting and credit teams by providing technical expertise and due diligence on soil carbon, forest carbon, and broader nature-based solutions, and advises on risk assessment for sustainability-linked lending. Prior to joining Compeer, Dr. Koirala worked with forest carbon developers, including Anew Climate and NativState. He holds a Ph.D. in Forestry and Natural Resources from the University of Georgia. Learn more about Dr. Koirala here: https://www.linkedin.com/in/anil-k-b64958191/

Phil Saksa | Blue Forest

Dr. Saksa is a Co-Founder and Chief Program Officer of Blue Forest. He works with research groups, conservation finance firms, stakeholders, and land managers to develop innovative approaches to funding and implementing natural resource management, working towards a collective mission to create ecologically resilient and sustainable landscapes. Dr. Saksa holds a Ph.D. in Environmental Systems from the University of California. Learn more about Dr. Saksa here: https://www.linkedin.com/in/phil-saksa/

Session: Poster Session

Biomass Inventory Optimization for Willow Based Pellet Production Integrating Seasonal Supply and Stochastic Demand

Zhuoxiao Wu, Recent Graduate (M.S.), Colorado State University (*akilawu@colostate.edu*)
Yu Wei, Professor, Colorado State University
Nathaniel Anderson, Research Forester, Rocky Mountain Research Station, United States Forest Service

Biomass supply chains face both intrinsic challenges (low energy density, bulkiness, seasonality) and extrinsic challenges (market uncertainty). We develop a two-stage stochastic mixed-integer linear programming (MILP) model that configures an (s, S) inventory control policy for a willow-based facility while accounting for seasonal willow harvesting capacity and stochastic daily wood pellet demand. Using a case study of a proposed wood pellet production facility in Schenectady County, New York, USA, we evaluate model-suggested inventory control policies using multiple out-of-sample pellet demand scenarios. Inventory policies acquired from modelling multiple stochastic demand scenarios result in lower expected annual inventory-management cost relative to policies derived from using constant demand data and, more importantly, these policies reduce cost variability by 55% under moderate demand uncertainty, with the performance advantage potentially increasing as uncertainty levels rise. Test cases also show that frequent inventory policy adjustments provide cost savings, but gains may be outweighed by the practical challenge of implementing a daily policy. The model successfully accounts for seasonal supply constraints and stochastic market demand to facilitate a multi-feedstock strategy that offers additional supply chain resilience and associated cost reduction. The framework's computational efficiency and broad applicability make it suitable for adoption by diverse biomass industries with uncertainties in their supply chains.

Keywords: biomass supply chain; wood pellet; inventory management; two-stage stochastic programming

Summary: This MILP model uses (s,S) policies to optimize willow pellet inventory in NY under seasonal supply and stochastic demand. It cuts cost variability by 55% and boosts resilience via multi-feedstocks, providing key insights for facility managers.

Session: Poster Session

Blockchain User Survey

Tara Allohverdi, PhD Student, Department of Forestry, Michigan State University (*allohver@msu.edu*)
Emily Silver, Associate Professor, Michigan State University
Raju Pokharel, Assistant Professor, Michigan State University

Growing demand for supply chain transparency and climate impact accountability in the forest sector has increased interest in traceability methods. The Michigan State University Forest Carbon and Climate Program conducted a feasibility study on blockchain applications for forest product traceability and carbon tracking. An online survey distributed reached approximately 1,000 individuals, with 100 responses received (10%). Results indicate moderate to low awareness of blockchain technology with limited current use. Respondents identified improved transparency, verification of sustainability claims, and improved carbon credit tracking as key benefits. Concerns about cost, data privacy, interoperability, and uncertain return on investment may limit blockchain technology without economic incentives and trusted governance. The findings of this study provide guidance for policy discussions, identification of economic, governance, and transparency conditions. This information can then be used to design program initiatives and help the industry adopt blockchain technology.

Keywords: blockchain, carbon, track-and-trace

Summary: This presentation assesses attitudes of blockchain technology use in product traceability and carbon tracking. Results highlight stakeholder perspectives on benefits, implementation barriers, and needs to support adoption.

Session: Poster Session

Bridging Knowledge Gaps in US Timber Price Research: An Annotated Literature Review

Sujata Shrestha, Graduate Student, University of Arkansas at Monticello (*ss052563@uamont.edu*)
Sagar Chhetri, Assistant Professor, University of Arkansas at Monticello
Shaun Tanger, Associate Professor, University of Arkansas at Monticello
Matthew Pelkki, Professor, University of Arkansas at Monticello

Timber prices serve as key market signals for forest landowners, mill operators, and policymakers managing vast US timberlands. However, timber markets differ substantially between hardwood and softwood species. Hardwood markets supply high-value products, including flooring and cooperage, and exhibit species-specific demand patterns, whereas softwood markets are closely tied to housing construction cycles and tend to follow more predictable demand behavior. These differences create distinct market dynamics that existing research struggles to integrate. Thus, this review aims to consolidate and summarize key findings from existing timber price research. This review synthesizes 53 peer-reviewed articles published between 1995 and 2025 that examine timber price dynamics in the US, identified through systematic literature searches. Using a narrative synthesis approach, the literature was organized into three thematic areas: timber price trend analysis (34%), modeling techniques (24%), and economic and ecological drivers (42%). Results show a growing research focus over time, with most studies conducted at the regional or state levels, particularly in the US South. Trend analyses show regional fragmentation in hardwood prices, while southern pine markets exhibit episodic stability. Modeling studies reveal a strong methodological focus on softwood, but hardwood markets remain comparatively underexplored. Studies on price drivers highlight that softwood prices are strongly linked to housing starts and macroeconomic cycles, whereas hardwood prices respond more to export demand, pest outbreaks, and policy shocks. Findings also show the weak integration of ecological and social factors in modeling. This synthesis provides a roadmap for future research emphasizing species-specific analyses and evidence-based forest economic policy.

Keywords: narrative synthesis, price dynamics, market volatility, econometric modeling, ecological drivers

Summary: The review synthesizes 53 peer-reviewed studies on US timber price dynamics across three themes revealing market heterogeneity, strong focus on softwood studies, and gaps in hardwood and ecological research, offering a roadmap for future research.

Session: Poster Session

Does Wildfire Severity Impact the Provision of Ecosystem Services? A case study from the South Platte River Basin of Colorado

Sungeun (Katie) Cho, Graduate Research Assistant, Department of Forest and Rangeland Stewardship, Colorado State University (*sungeun.cho@colostate.edu*)
Srijana Baral, Assistant Professor, Department of Forest and Rangeland Stewardship, Colorado State University

Wildfires are key ecological drivers impacting natural ecosystems. In recent years, the frequency, size, and severity of uncharacteristic wildfires have increased in the western United States due to various environmental and biophysical factors, influencing the distribution of ecosystem. While this issue has been well acknowledged in the literature, studies examining the impacts of wildfire severity on ecosystem services across heterogenous land typologies is limited. Here, we extend our previous work by integrating the severity of wildfires as a factor attributing to the levels of three ecosystem services types (carbon storage, water yield, and habitat quality). Using the Integrated Valuation of Ecosystem Services and Tradeoffs modules and regression analysis, we model variation in ecosystem services from 2004 to 2024 within the South Platte River Basin, Colorado. Our results provide landscape-specific insights that can support decision-making under wildfire uncertainty and inform tailored wildfire management strategies.

Keywords: burn size, conservation values, environmental benefits, natural ecosystem, wildfire

Summary: We develop an integrated scope incorporating multiple land types to assess how wildfire severity and burn area influence key ecosystem services (carbon storage, water yield, and habitat quality).

Session: Poster Session

Economic Growth and Market Concentration in U.S. Interstate Wood Product Trade

Basana Sapkota, Graduate Student, Michigan State University (*sapkota2@msu.edu*)
Raju Pokharel, Assistant Professor, Michigan State University
Kamana Poudel, Postdoctoral Scholar, Michigan State University

Interstate wood product trade in the United States operates as a network of supplying and consuming states, whose structure shifts under different economic growth conditions. Forest sector models often project how total harvest and trade volumes respond to alternative economic scenarios. However, they rarely examine how these scenarios alter trade connections between states, including whether trade becomes more concentrated or competition shifts across regions. Using the Land Use and Resource Allocation (LURA) partial equilibrium forest sector model, this study simulates 15-year interstate trade flows for hardwood and softwood sawlogs and pulplogs under base, high-, and low-growth economic scenarios. These flows are represented as interstate trade networks to evaluate changes in connectivity, trade concentration, and competitive positioning among states. Findings reveal that high-growth conditions expand interstate connectivity and increase cross-regional interdependence, leading to a denser and more competitive trade structure. In contrast, low-growth conditions contract the network and increase the concentration of trade flows among a smaller number of dominant supplying states. By visualizing and quantifying interstate wood flow networks, this study demonstrates how macroeconomic conditions reshape market structure and regional exposure. The results provide insights into market resilience, procurement risk, and strategic investment planning under alternative economic futures.

Keywords: interstate wood product trade, market concentration, macroeconomic growth scenarios, forest sector modeling, LURA model, U.S. timber markets

Summary: This study analyzes how alternative economic growth scenarios reshape U.S. interstate wood product trade. Using the LURA model, it assesses changes in trade connectivity, market concentration, and competition under different economic conditions

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Session: Poster Session

Influence or Interference? Understanding Crowding Effects in Forest Management Adoption

Jean Fritz Saint Preux, Graduate Research Assistant, Purdue University (*jsaintpr@purdue.edu*)
Bindu Paudel, Phd Student, Purdue University
Benjamin David Wegener, Undergraduate Student, Purdue University
Mo Zhou, Associate Professor, Purdue University

More than half of the private forestland in the U.S. is under non-industrial private forest (NIPF) ownership. Understanding NIPF landowners' decision-making is crucial for developing effective policy that promotes sustainable forest management practices and ensures forest health. This study investigates the factors influencing the adoption of different management practices, with a focus on potential crowding effects among these practices. Drawing on data from over four hundred NIPF landowners in the U.S. central hardwood region, a series of binary logistic regression models were employed to analyze the relationship between landowner and forestland characteristics and the likelihood of adopting various management practices, like invasive plant management, forest stand improvement, and grapevine control. The findings reveal that factors, such as forest acreage, proximity of landowner residence to the forest, and education level, significantly affect the likelihood of adopting management practices. More importantly, this study found evidence of crowding-in effects, where implementing one practice increased the probability of adopting others, suggesting a preference among NIPF landowners for a diverse approach to forest management.

Keywords: forest management, non-industrial private forest, crowding effect, landowner decision-making

Summary: This presentation examines factors influencing the adoption of sustainable forest practices using survey data and logistic regressions. Results show that forest size and proximity matter, and adopting one practice affects the adoption of others.

Session: Poster Session

Effects of Coastal Flooding and Storm Surge on Wood Product Demand in the United States

Anusha Shrestha, Graduate Research Assistant, Department of Forestry, Mississippi State University (*as5385@msstate.edu*)
Ram Adhikari, Assistant Professor, Department of Forestry, Mississippi State University
Robert Grala, Professor, Department of Forestry, Mississippi State University
Prakash Nepal, Research Economist, Forest Products Laboratory, USDA Forest Service
Rajan Parajuli, Associate Professor, Department of Forestry and Environmental Resources, North Carolina State University

Communities along the US coast are increasingly at risk from coastal flooding and storm surge, which can affect built infrastructures and natural resource bases. Among the affected sectors, domestic wood product market is particularly sensitive due to its significance in supplying construction materials for residential housing starts. This study examines how coastal flooding and storm surge events impact the domestic wood product market, with a specific focus on changes in sawnwood demand in the US. Using publicly available national-level data on sawnwood demand and other demand shifters including sea level rise from 1970 to 2024, this study develops an econometric model to estimate the effect of coastal flooding and storm surge on wood product demand in the US. The sea level rise in US coastal areas was used as the proxy for coastal flooding and storm surge. In the US, sea level rose 16 centimeters from 1970 to 2024 and is expected to continue rising as long as weather system changes. Initial empirical results indicate sawnwood demand was increased with the sea level rise and growth in the economy over the study period. The finding implies that increased exposure to coastal flooding and storm surge relates to higher wood product consumption, likely driven by movement of people away from coastal areas, and new residential housing development. Thus, the study further suggests that establishing a policy that helps increase the production of wood products domestically to meet the growing wood demand caused by various climate threats.

Keywords: climate threat, sawnwood consumption, sea level rise, wood product market

Summary: This study examines how sea level rise and coastal flooding affect U.S. sawnwood demand (1970–2024). Results show rising sea levels and economic growth increase wood consumption, likely driven by housing development and climate-related relocation.

Session: Poster Session

Effects of Logging on Wildlife-Vehicle Collisions

Samuel Nonemaker, PhD Candidate, The University of Wyoming (*snonemak@uwyo.edu*)

Wildlife-vehicle collisions impose substantial and persistent economic and social costs in the United States. While the costs of these collisions are well documented, less is known about how human land-use activities shape overall risk. In this paper, I examine whether logging affects wildlife-vehicle collision rates by altering habitat conditions near roadways. Although logging might not permanently change land-use classification, it can increase edge density, early successional vegetation, and forage availability, potentially attracting ungulates closer to or further away from roads. Drawing on ecological evidence linking wildlife abundance and habitat fragmentation to collision risk, I evaluate whether forest disturbance from timber harvests changes collision incidence. By connecting forest management practices to transportation safety outcomes, I hope to inform policymakers about an overlooked channel through which logging may generate external costs/benefits.

Keywords: externalities, wildlife-vehicle collisions, forest management

Summary: This study examines whether timber harvesting influences wildlife-vehicle collision rates by altering roadside habitat conditions and wildlife movement patterns

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Exploring Alternative Northern Hardwood Management and Regeneration Options to Enhance Restoration.

Emilie Hebenstreit, Graduate Student, Michigan State University (*Hebenst3@msu.edu*)
Raju Pokharel, Assistant Professor, Michigan State University
Michael Walters, Associate Professor Emeritus, Michigan State University
Claudia Bartlick, Postdoctoral Scholar, Michigan State University
Aiden Morales, Research Assistant, Michigan State University

Northern hardwood forests are having issues with regeneration because of pests, pathogens, climate change, and wildlife pressures. Understanding how different management methods and harvest intervals influence regeneration is important for determining changes in forest composition and health. We did growth and yield analysis for different regeneration scenarios using FVS and forest inventory and analysis (FIA) data (800-level forest types or the northern hardwoods). Different management scenarios consisted of no management with FVS predicting regeneration, no management with no regeneration (or worst case), and thinning with no regeneration (or business-as-usual). Our preliminary findings show significant differences in future forest conditions with different regeneration scenarios. The results of this study aim to assist policymakers, stakeholders, and land managers with decision-making regarding the best harvesting method for northern hardwood regeneration.

Keywords: forest vegetation simulator, fvs, silviculture, management methods, forest resiliency, northern hardwoods

Summary: FVS was used to model current management, thinning, against no management and an alternative management approach to determine the best management method for northern hardwood regeneration.

Session: Poster Session

Feedstock Availability and Cost Analysis for Hardwood Mass Timber in Michigan

Ichchha Thapa, PhD Candidate, Michigan State University (*thapaich@msu.edu*)
Raju Pokharel, Assistant Professor, Michigan State University
Greg Latta, Research Associate Professor, University of Idaho
Emily Silver, Associate Professor, Michigan State University
George Berghorn, Assistant Professor, Michigan State University
Jagdish Poudel, Forest Economist, Michigan Department of Natural Resources
Sandra Lupien, Director, Masstimber@MSU, Michigan State University

With over 70% of its forest composition consisting of hardwoods, Michigan has great potential to create a niche market for hardwood-based mass timber products. This study assesses the availability of feedstock and cost of manufacturing mass timber in Michigan from 2025 to 2040 using a GIS based network analysis and the Land Utilization and Resource Allocation (LURA) model to optimize supply and demand across different manufacturing and feedstock scenarios. The study identified four optimal locations for prospective mass timber manufacturing facilities. With hardwood-only feedstock scenario, optimal facility favored locations closer to demand centers, reflecting procurement costs considerations. In addition, secondary manufacturing was found to be more cost-efficient compared to integrated manufacturing model. This study offers valuable insights into the trade-offs between optimal locations and manufacturing models to manufacturers and decision-makers seeking to make informed decisions on developing hardwood-based mass timber industry in Michigan.

Keywords: manufacturing, network analysis, hardwoods, engineered wood, innovation

Summary: This study identifies optimal locations and manufacturing model for hardwood-based mass timber in Michigan by assessing feedstock availability and manufacturing costs across different scenarios using network analysis and LURA model.

Session: Poster Session

ForCAST: Forest Carbon Assessment & Statutory Tracker

Ethan Vanantwerp, Graduate Student, Michigan State University (*vanant22@msu.edu*)
Raju Pokharel, Assistant Professor, Michigan State University

Addressing the need to help visualize and display forest carbon policies across the lower 48 states. A webtool has been developed to map forest carbon policy. Webtool design would aid users in determining the location and size of land tracts being used to generate carbon credits in accordance with Improved Forest Management (IFM) methodologies across both voluntary and compliance markets. Data for these projects is pulled from the ACR, CAR, and VERRA registries and displayed for users to look at local change in use on the landscape. Legal and managerial policies relating to forest carbon will also be displayed for each state in the continental United States. Available to users is the ability to view changes of policy both across the landscape and legally over time. Policy makers, property owners, forest product industry professionals, and researchers would benefit from a consolidated source of information related to forest carbon policy and its variation across the United States over time.

Keywords: carbon markets, forest carbon policy, governance, improved forest management, webtool

Summary: Mapping webtool for the lower 48 states, displaying information related to forest carbon policies. Using data from ACR, CAR, and Verra, it visualizes landscape changes and state-level policies for users to track overtime.

Session: Poster Session

From Shock to Recovery: Economic Resilience of Southern Pine Forests Under Natural Disturbance

Simran Pandey, Graduate Student, Mississippi State University (*sp2415@msstate.edu*)
Sabhayta Lamichhane, Assistant Professor, Mississippi State University
Ram Adhikari, Assistant Professor, Mississippi State University
Eric McConnell, Associate Professor, Mississippi State University

Pine plantations are a significant contributor to the Southern US economy, representing about 60% of the total forest harvest. Natural disturbances like fire, hurricanes, and pest outbreaks are major risks leading to huge economic losses, influencing pine forest management decisions. Despite this, there are limited empirical studies connecting the post-disturbance economic recovery trajectories with forest value dynamics and management strategies. This study aims to analyze the rate and drivers of economic recovery in Southern pine forests following natural disturbances under the current forest management strategy. To achieve this, we will use an analytical framework incorporating stand-level growth and yield simulations based on the Forest Vegetation Simulator. The framework will assess economic resilience through four core components: economic resilience metrics, forest value estimation under disturbance risk, optimization for maximizing economic return, and scenario analysis to examine the mechanisms driving recovery. We expect to observe gradual post-disturbance recovery in timber markets, with recovery rates and forest value outcomes sensitive to alternative market conditions and management scenarios. By understanding economic resilience, we aim to offer insights into localized market impacts and recovery dynamics, shaping landowner decision-making and long-term management.

Keywords: disturbance economics, forest management, forest value, optimization, quantifying resilience

Summary: This study analyzes post-disturbance recovery in southern pine plantations to quantify economic resilience through forest value dynamics and management strategies that inform landowner decision-making and long-term forest management.

Session: Poster Session

Governing landscapes in the Anthropocene: Adaptive governance and resilience outcomes at the local level

Marc Castellón-Durán, College of Forestry & School of Public Policy, Oregon State University
Mindy Crandall, Associate Professor in Forest Policy and FERM Interim Department Head, Oregon State University
Erika Wolters, Associate Professor in Political Science; Associate Director Water Resource Policy and Management Graduate Program, Oregon State University

In the 1990s, leading social science researchers Elinor Ostrom and Carl Folke developed the concept of social-ecological systems (SES) to define complex landscapes in which resource use is inseparable from long-term environmental and human development. Thirty years later, interdisciplinary efforts are still struggling to operationalize the components of the Social-Ecological Systems Framework (SESF). This is, partially, the result of a shortage of empirical research over the last decade, which has led to a lack of primary data for comparative analyses. A transdisciplinary exploration of SES as complex adaptive systems could allow for testing the second-tier variables in Ostrom's SESF. This poster will describe a research plan to specify the framework's governance component through a grounded approach. Our project will employ applied social science methods (i.e. in-depth semi-structured/unstructured interviewing and participatory focus groups) to gather data on forest governance in two Global North settings, Northeastern Spain and Western Oregon. We will translate key concepts of adaptive governance into lay terms to provide topics of discussion. Conversations will run with attention to ensuring the participants' full freedom to answer in meaningful ways. Analysis will then be applied to determine whether the concepts derived from the SESF are deemed relevant, and to propose potential changes to the framework's governance component. This grounded approach will maximize the quality and quantity of our inputs, resulting in rich data for primary and secondary uses. Broadly, our project explores how we can rejuvenate the debate on making natural resource governance sustainable, effective, and acceptable to rural communities.

Keywords: wildfire suppression, risk management, climate impacts

Summary: We assessed the influence of weather conditions, terrain features, personnel availability, tree canopy cover, fire containment lines, and previously identified 'best available' containment features.

Session: Poster Session

How Do Iinstitutional and Regional Factors Contribute to the Forest Mill Dynamics in the U.S.?

Sofwaan Bakary, Graduate Research Assistant, university of Tennessee (*sbakary@vols.utk.edu*)
Noel Perceval Assogba, Assistant Professor, University of Tennessee
Consuelo Brandeis, Research Forester, U.S. Forest Service

This study investigates the factors influencing the operational status of forest mills in the United States, with particular attention to ownership dynamics, certification, and regional characteristics. Using a dataset of 1,802 mills and applying a logistic regression framework, the analysis evaluates the probability of mills remaining operational based on institutional, market, and structural variables. The results indicate that frequent ownership changes significantly reduce the likelihood that a mill remains open, suggesting that ownership instability weakens long-term operational viability. In contrast, certified mills exhibit a higher probability of remaining operational, highlighting the role of certification in supporting market competitiveness and operational resilience. Regional factors also appear important, with mills located in the U.S. North and South showing higher survival probabilities relative to the reference region. Overall, the findings emphasize the importance of ownership stability, certification, and regional conditions in shaping mill survival within the U.S. forest products industry.

Keywords: forest mill closure, ownership dynamics, certification, logistic regression, U.S. forest industry

Summary: This study investigates the factors influencing the operational status of forest mills in the United States, with particular attention to ownership dynamics, certification, and regional characteristics.

Session: Poster Session

Identifying Merchantability Opportunities in California's Priority Landscapes: A strategy for Wildfire Risk Mitigation

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Justin Baker, Professor, North Carolina State University.
Greg Latta, Professor, University of Idaho.
Raju Pokharel, Professor, Michigan State University.
Sam Evans, Forest Economist, CAL FIRE.

Forested areas across much of the western United States have changed significantly in terms of structure, species composition, ecological processes, and wildfire regime characteristics. Consequently, their resilience and resistance to rapidly changing wildfire and climatic regimes have been altered. This shift in resilience, caused in part by decades of fire suppression, a decline in fire frequency in the 20th century, persistent drought, insect outbreaks, and years with relatively warm and dry climatic conditions, has resulted in large and intense western wildfires in recent years. Thus, the socioeconomic and ecological impact of these wildfires suggests a need for more proactive and active management of forest landscapes.
Market development is an essential part of the long-term strategy to reduce fuels through active, sustainable management of forest landscapes to mitigate potential carbon losses associated with policy efforts to increase forest resilience to wildfire. This project fills a current knowledge gap by analyzing the important roles of market dynamics, competition, and spatial dependencies to evaluate the economic and greenhouse gas (GHG) impact of wildfire management efforts. Specifically, we analyze the Priority Investment Landscapes (PILs) in California to quantify potential biomass volumes from vegetation management and wildfire fuel-reduction treatments in these landscapes and assess the role of existing market infrastructure to identify areas where additional facilities could support active forest management for the next 20 – 30 years. We identify priority landscape areas based on market extent and market competition and classify each into quintiles for three harvested wood products (sawlogs, pulpwood, biomass). This information is critical for maximizing the benefits or minimizing the costs of fuel-reduction strategies, identifying optimal locations for new facility investments, and better prioritizing forest health improvement and wildfire mitigation funding programs. Our research serves as a strategic assessment designed to identify areas where a more detailed tactical analysis might be justified.

Keywords: forest product supply chain, harvest wood products, network anaysis

Summary: This study is critical for maximizing the benefits or minimizing the costs of fuel-reduction strategies, identifying optimal locations for new investments, and better prioritizing forest health improvement and wildfire mitigation funding programs.

Session: Poster Session

Post-Contract Forest Persistence under the Conservation Reserve Program: Evidence from the Pacific Northwest

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Dr. Srijana Baral, Assistant Professor, Colorado State University

The Conservation Reserve Program (CRP) is a voluntary initiative that promotes the conversion of highly erodible and other environmentally sensitive land into vegetative cover, including trees, riparian buffers, and native grasses, enrolling millions of acres in contracts lasting ten to fifteen years. While the majority of the research focuses on enrollment trends and environmental benefits, the persistence of forest cover after contracts expire is less well understood. Understanding post-contract land-use dynamics is increasingly important as conservation programs are positioned as long-term climate mitigation tools.
This study examines post-CRP forest persistence in the Pacific Northwest region using a county-level panel that links CRP tree enrollment data from the USDA Farm Service Agency with Land Use and Land Cover data from the National Land Cover Database (NLCD). An event-time framework is used to track forest cover before enrollment, during the contract period, and several years following expiration.
Available literature based on landowner surveys shows different persistence patterns across counties. Forest persistence may not change when a contract expires in regions with robust timber markets and higher baseline forest cover. In contrast, counties with higher agricultural opportunity costs may exhibit partial reversion following contract termination. These findings would suggest that the long-term durability of CRP tree plantings depends critically on regional land-use pressures and economic conditions. This study examines spatial patterns of CRP tree persistence and contributes to the discussion on conservation permanence.

Keywords: conservation reserve program, persistence, pacific northwest, post-contract land use, reversion

Summary: This poster examines whether forests established under CRP tree contracts persist after expiration in the Pacific Northwest. Linking CRP enrollment data with NLCD land-cover data, we track forest dynamics before and after contracts.

Session: Poster Session

Regime-Dependent Price Dynamics in U.S. Southern Stumpage and Lumber Markets

Michael McIntosh, Post-Doctoral Fellow, Auburn University (*mgm0151@auburn.edu*)
Daowei Zhang, Professor, Auburn University

This paper examines historical U.S. Southern stumpage and lumber prices using a nonlinear time-series model known as the Smooth Transition Autoregressive Distributed Lag Error Correction Model (ST-ARDL-ECM). In economic theory, it is widely acknowledged that market dynamics vary across distinct time periods (regimes). This research extends traditional modeling by testing whether market integration and price transmission differ between regimes and indicates the "points" of transition between the regimes within the stumpage and lumber series.

Keywords: ST-ARDL-ECM, integration, stumpage prices, lumber prices

Summary: This presentation examines historical U.S. Southern stumpage and lumber prices using a nonlinear time-series model known as the Smooth Transition Autoregressive Distributed Lag Error Correction Model (ST-ARDL-ECM).

Session: Poster Session

Regulatory Impact on Riparian Buffer Policies: A Parcel-Level Pilot Study in Lane County, Oregon

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Keeryun Cho, Graduate Research Assistant, Oregon State University
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Recent implementation of riparian buffer regulations under the Oregon Private Forest Accord introduced differentiated standards to improve equity among private forest landowners, particularly small forest landowners. However, limited empirical evidence exists regarding how alternative buffer regulations may differentially affect parcel-level regulatory exposure. This study will examine how standard buffer regulations and small forest landowner minimum buffer regulations influence the proportion of regulated areas at the parcel level in Lane County, Oregon. Using parcel level ownership data and hydrologic stream layers from the Oregon Department of Forestry, spatial overlay analysis will be conducted to calculate the share of regulated areas under each regulatory scenario. Regulatory exposure will be measured as the percentage of parcel area affected by riparian buffer requirements, and differences between scenarios will be estimated for each parcel. The analysis will assess whether average regulatory differences are substantial and whether impacts are evenly distributed across ownership types. Ownership heterogeneity between industrial and non-industrial private forest landowners will be examined. While average differences may be modest, the distribution of impacts is expected to vary across ownership types. The findings will contribute to understanding whether differentiated buffer policies meaningfully enhance regulatory impact and whether specific ownership groups face concentrated regulatory exposure. While this pilot focuses on spatial regulatory exposure, future extensions will integrate economic metrics such as compliance costs and net present value impacts to assess the financial implications of differentiated buffer policies.

Keywords: riparian buffer regulation, private forest landowners, parcel level analysis, regulatory impact

Summary: This study analyzes how differentiated riparian buffer standards under the Oregon Private Forest Accord shape parcel-level regulatory exposure across private forest ownership types in Lane County.

Session: Poster Session

Spatial Optimization of Prescribed Fire to minimize Wildfire Incidence in Mississippi

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Rajeev Bhattarai, Professor, Mississippi State University
Robert Grala, Professor, Mississippi State University

Prescribed fire plays a major role in the mitigation of wildfire risk across the US, including Mississippi. However, prescribed fire has been declining as a tool over the past decade, which could have dangerous consequences on the potential for greater wildfire incidence and its associated suppression costs as the frequency of extreme climatic events increases. Despite several management interventions, wildfires have posed a persistent threat to Mississippi's forest lands over the years. There is no empirical study analyzing the impact of spatial distribution of prescribed fires on wildfire incidence. This study analyzes the impact of prescribed fire spatial distribution on wildfire incidence in Mississippi and identifies strategies to minimize wildfire suppression costs. To do this, data on the occurrence of wildfire and prescribed fire was analyzed for each county over every year from 2016 through 2024 in a panel regression along with other control factors such as weather, vegetation type, topography and road network. Initial results indicate that prescribed fires conducted in the wildland–urban interface, particularly when implemented at greater frequencies, help reduce wildfire incidence in Mississippi. We hope this finding can inform decision makers such as the Mississippi Forestry Commission about how they can optimize prescribed fires to best reduce wildfire risk while minimizing the suppression costs.

Keywords: panel regression, spatial distribution, suppression cost

Summary: Optimizing prescribed fire distribution helps reduce wildfire. Mississippi county data (2016–2024) were analyzed using panel regressions. Frequent prescribed burns in wildland–urban interfaces are associated with lower wildfire incidence.

Session: Poster Session

What Factors Affect Forest Management Expenditures in Mississippi?

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Robert K. Grala, Professor, Mississippi State University

Timber production remains the central focus of forest management in Mississippi and a significant component of forestland value. Given that the majority of forestland in Mississippi is owned by non-industrial private forest landowners, their management decisions and expenditures strongly influence the economic viability of timber production. However, it is unclear how socioeconomic and biophysical factors affect the expenditures landowners incur on forests in Mississippi, which may increase the likelihood of forestland conversion to other land uses. A logistic regression framework was used to model the forest management expenditures as a function of the acreage of forestland owned, land productivity, proximity to the market centers, population density, household income, and farmland earnings. Forest management expenditure data were collected from mail surveys of forest landowners, whereas land productivity, population density, farm earnings, and household income were obtained from secondary sources, including the U.S. Census Bureau and U.S. Bureau of Labor Statistics. Income is expected to be positively associated with management expenditures, as higher income increases the likelihood of engaging in active forest management and timber production activities. The expected increases in population density and household income raise concerns about maintaining forest sustainability and about the potential for conversion to other land uses. The results provide insights into how various factors shape trends in forest management expenditures and will help develop more effective timberland management strategies.

Keywords: forestland values, land conversion, land productivity, management expenditures.

Summary: This study analyzes how various factors affect forest management costs among landowners in Mississippi. Using logistic regression, we examine how income, population density, land productivity, acreage, and market access shape management decisions.

Session: Poster Session

Lumber Price Shock Revisited: The "Asset-Buffer" Role of the U.S. Housing Market

Sofwaan Bakary, Graduate Research Assistant, University of Tennessee (*sbakary@vols.utk.edu*)
Noel Perceval Assogba, Assistant Professor, University of Tennessee

This study examines how U.S. lumber demand responded to the 2021 lumber price supercycle, one of the most extreme commodity price episodes in modern forest product markets. Using annual data from 2000 to 2024 and applying the Synthetic Control Method, the analysis constructs a counterfactual trajectory for U.S. apparent lumber consumption to isolate the quantity effects of the price shock. The results indicate that the United States consumed approximately 15–20% more lumber between 2022 and 2024 than would have occurred in the absence of the 2021 price surge. To explain this apparent demand resilience, the study investigates the timing of price transmission across housing markets and consumer housing costs. Lead–lag diagnostics and distributed-lag regressions show that lumber price growth predicts housing price growth with a one-quarter delay, while shelter inflation responds two to four quarters later. These dynamics suggest a housing-asset buffering mechanism in which rising construction costs are initially absorbed through housing asset prices before being transmitted to households through shelter inflation.

Keywords: lumber price shock, synthetic control method, housing market, price transmission, U.S. lumber demand

Summary: This study examines how U.S. lumber demand responded to the 2021 lumber price supercycle, one of the most extreme commodity price episodes in modern forest product markets.

Session: 1. Forest Product Markets: Price Dynamics, Policy Impacts, and Market Behavior

Lumber Price Shock Revisited: The "Asset-buffer" Role of the U.S. Housing Market

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Noel Perceval Assogba, Assistant Professor, University of Tennessee

This study examines how U.S. lumber demand responded to the 2021 lumber price supercycle. Using annual data from 2000 to 2024 and applying the synthetic control method, the results indicate that U.S. lumber consumption was approximately 15–20% higher in 2022-2024 than it would have been in the absence of the 2021 price surge. Lead–lag diagnostics and distributed-lag regressions further show that increases in lumber price predict increases in housing price with a one-quarter delay, while shelter inflation responds two to four quarters later. These dynamics suggest a housing-asset buffering mechanism in which rising construction costs are initially absorbed through housing asset prices before being gradually transmitted to households through shelter inflation.

Keywords: lumber price shock, synthetic control method, housing market, price transmission, U.S. lumber demand

Summary: This study examines how U.S. lumber demand responded to the 2021 lumber price supercycle.

Session: 1. Forest Product Markets: Price Dynamics, Policy Impacts, and Market Behavior

Strategic Bidding and the Reserve Price Distortion in State Timber Auctions

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This study analyzes strategic price overbidding in Michigan Department of Natural Resources (DNR) first-price, sealed-bid timber auctions and the resulting distortion in reserve-price formation. Bidders submit unit prices by species, but the tract is awarded to the bidder with the highest aggregated total. Because DNR updates reserved prices from 365 days rolling averages of winning unit bids, it allows bidders to overbid one or few species by dumping extreme unit prices to raise the tract total, while bidding near the advertised price on the remaining species. Using statewide DNR auction records from 2014 to 2025, we examine three questions: who overbid, which products & species are targeted, and how alternative reserve-updating rules perform. Preliminary results show that overbidding is concentrated among large firms and occurs mainly in pulpwood; extreme overbids disproportionately target small, infrequently offered species and low-value tract components. We compare the current DNR's cap-and-spread ($\mu+2\sigma$) cleaning rule to a trimmed mean and a hard cap, focusing on reserve levels and price volatility. Cleaning reduces reserve inputs and substantially lowers volatility, but it can also spread a spike across all species in a tract. A tract-level linear-programming counterfactual shows 57.2% of overbid wins are avoidable, yet bidders face a 42.8% probability of losing without overbidding. This constraint is even extreme for small firms: only 29.7% of their overbid wins are avoidable, and in more than half of their wins some cap breach is required to beat the runner-up. Comparing alternatives, cap-based rules look best for pulpwood, while trimmed estimators perform better for sawtimber.

Keywords: overbidding, timber auction, sealed bid, bidders

Summary: Overbidding is concentrated among large firms, mainly in pulpwood, and targets low-volume, infrequently offered species. Cleaning lowers reserve inputs and volatility, but many wins still rely on overbidding.

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Session: 1. Forest Product Markets: Price Dynamics, Policy Impacts, and Market Behavior

Time-Varying Price Elasticity of Supply for Wood Products under Emerging Forest Carbon Policies

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Srijana Baral, Assistant Professor, Colorado State University
Raju Pokharel, Professor, Michigan State University

The rapid expansion of forest carbon credit markets is increasingly influencing wood flow, forest investment decisions, and raw material procurement within forest product industries. While forests play a critical role in achieving net-zero emission targets as a natural climate solution, prioritizing carbon sequestration may alter traditional forest management regimes. Extended rotation lengths, reduced harvest levels, and shifts in product composition could constrain the steady supply of timber required by wood-processing facilities and forest-dependent communities. In this study, we examine the time-varying price elasticity of supply for three major softwood stumpage product types including pulpwood (PW), chip-n-saw (CNS), and sawtimber (ST) to understand how market changes under changing economic and policy conditions. Because PW, CNS, and ST are jointly produced, we use a Seemingly Unrelated Regression and embed the SUR within a state-space model with the Kalman filter, allowing price elasticities to follow a stochastic process over time. Using annual data from 2007-2022, the model incorporates product prices, standing inventory, housing starts, fuel prices, harvest taxes and other macroeconomic variables. This period captures major structural disruptions, including the 2008 financial crisis, COVID-19 market volatility, and the recent expansion of forest carbon enrollment. By advancing a time-varying econometric framework for stumpage price analysis, this study contributes to understanding how forest carbon policies influence timber market dynamics and provides empirically grounded inputs for forest market modeling efforts.

Keywords: forest products, forest carbon, price elasticity

Summary: This study contributes to understanding how forest carbon policies influence timber market dynamics and impact price elasticity of supply for three major softwood stumpage product types including pulpwood, chip-n-saw and sawtimber.

Session: 1. Forest Product Markets: Price Dynamics, Policy Impacts, and Market Behavior

What Drives Oak Timber Prices? Evidence from Arkansas Timber Markets

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Dr. Shaun Tanger, Associate Professor, University of Arkansas at Monticello
Dr. Matthew Pelkki, Professor, University of Arkansas at Monticello

Oak represents around 38% of Arkansas timberland and supplies high-value products such as furniture, flooring, cooperage, and railroad ties due to its strength and durability. In Arkansas, the annual growth of hardwoods exceeds removal levels, suggesting substantial potential for increased harvesting and utilization. Despite this, the timber market faces challenges, including price volatility, limited market-focused research, and shifting global demand. While many studies have examined price determinants for softwoods, relatively few have focused on hardwoods, particularly oak, despite their economic and ecological importance. Addressing this research gap is crucial for better understanding the unique market behavior of oak. This study analyzed quarterly oak stumpage, delivered, and lumber prices (1990-2024), assessed long-term trends, and identified key drivers of price dynamics in Arkansas using a multivariate time-series Vector Error Correction Model (VECM). Results showed that harvest reduction policies positively influenced stumpage and delivered prices, while GDP fluctuations and the COVID-19 pandemic negatively affected stumpage prices. The Red Oak Borer outbreak and historical events like the Dotcom Bubble significantly influenced delivered and lumber prices. Lagged mortgage rates and lumber prices also contributed to price adjustments. The study indicates how strongly and quickly macroeconomic variables, policies, and market shocks were transmitted into oak prices, and whether these responses were symmetric over time. The findings provide actionable insights for landowners and mill operators on harvest scheduling and price risk management, while equipping policymakers with localized insights to balance economic utilization with sustainable forest management objectives.

Keywords: price trends, stumpage markets, time series analysis, economic shocks, harvest reductions

Summary: The research analyzes oak timber prices in Arkansas using VECM to assess long-term trends and key price drivers. It highlights the role of macroeconomic cycles, policies and market shocks, with insights for harvest planning and price risk management.

Session: 1. Forest Product Markets: Price Dynamics, Policy Impacts, and Market Behavior

How Do Institutional and Regional Factors Contribute to Forest Mill Dynamics in the U.S?

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Noel Perceval Assogba, Assistant Professor, University of Tennessee
Consuelo Brandeis, Research Forester, U.S. Forest Service

This study investigates the factors influencing the operational status of forest mills in the United States. Using a dataset of 1,802 mills and applying a logistic regression framework, the results indicate that frequent ownership changes significantly reduce the likelihood that a mill remains operational, suggesting that ownership instability undermines long-term operational viability. The findings highlight the critical roles of ownership stability, certification, and regional conditions in shaping mill resilience within the U.S. forest products industry.

Keywords: forest mill closure, ownership dynamics, certification, logistic regression, U.S. forest industry

Summary: This study investigates the factors influencing the operational status of forest mills in the United States.

Session: 2. Forest Product Industry Structure and Mill Dynamics

Determinants of Primary Timber Processing Facility Closure in Colorado: A Survival Analysis

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Mahesha Kuluppuarchchi, post-doctoral scholar, Colorado State University
Srijana Baral, Professor, Colorado State University

The forest products industry in the United States plays a vital role in sustaining rural economies, providing employment opportunities, and supporting healthy forests. Over the past several decades, a pattern of timber processing facility closures has been observed across the US. While this trend of closures is evident, little research has been conducted to determine the factors behind it. Using a Comprehensive Log-Log model for discrete time survival analysis we evaluate how internal and external factors affect patterns of mill closure in Colorado from 2002-2020. Our findings suggest that mill structure has a significant influence on mill closure, as do important socioeconomic factors such as workforce dynamics and timber availability on Federal lands. Results of this study highlight the significance of Federal timber availability and availability of skilled employees, supporting policy surrounding stewardship contracts and forestry workforce development in the state of Colorado. Contribution of structural covariates to survival probability informs importance of targeted policy support dependent on mill size and product type.

Keywords: complementary log-log model, forest products industry, mill survival, industry structure

Summary: Study uses survival analysis to examine determinants of primary mill closure in Colorado using longitudinal survey data. Mill structure, workforce, and timber supply influence closure risk. Results emphasize industry structure and timber supply.

Session: 2. Forest Product Industry Structure and Mill Dynamics

Determining Market Linkages and Impacts from Mill Capacity Flux

Matt Clutter, PhD Student, SOFAC RA, North Carolina State University (*mclutte@ncsu.edu*)
Justin Baker, Associate Professor, SOFAC Director, North Carolina State University

The colloquial "wall of wood" in the U.S. South has been a hurdle for landowners in recent years. Oversupply of available biomass across much of the landscape has led to persistently suppressed prices for all log classes following the highs and subsequent crash resulting from the 2008 global financial crisis. The producer surplus problem for Southern landowners has only worsened in recent years for small diameter logs, as a slew of mill closures has only increased the delta between available wood and demand for the logs. This has led to sharp price declines for many landowners in the last 3 to 4 years following a brief COVID associated boom. These price responses serve as a true market measure for the overall demand for small diameter logs, relative to available stock within a mill's wood basket. For many landowners, price is often observed as a regional aggregation, based on sale locations within FIA region. While these regions are informative for creating homogeneity among factors like species and site quality on the supply side of markets, they do not perfectly reflect the spatial realities of demand. Mill procurement practices are driven by cost-minimization relative to available stock and operating costs within its sourcing area, which is spatially explicit from neatly drawn regions. This paper seeks to use a set of assumptions about normal mill procurement, available stock, and available processing capacity to draw linkages between price regions and infer price dynamics for those regions based on the available mill processing capacity.

Keywords: mill closure, price, spatial linkages

Summary: Examining the observed price effects and resulting spatial correlation from capacity flux for small diameter log mills in the Southeastern United States.

Session: 2. Forest Product Industry Structure and Mill Dynamics

Interstate Wood Product Flows and Market Competition in the USA Under Different Economic Scenarios

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Kamana Poudel, Postdoctoral Fellow, Michigan State University

Macroeconomic growth trajectories play a central role in determining demand for primary forest products and altering regional trade patterns across the United States. While previous studies and models project trade flows under alternative scenarios, limited attention has been given to how these scenarios reshape interstate trade structure, including the concentration of trade shares among supplying states and competitive dynamics across regions. This study projects 15-year interstate trade flows for four major forest product categories: hardwood sawlogs, softwood sawlogs, hardwood pulplogs, and softwood pulplogs under base, high-growth, and low-growth economic scenarios using the Land Use and Resource Allocation (LURA) partial equilibrium model. Interstate wood flows are evaluated to assess changes in market interdependence, competition intensity, and trade concentration across states and product categories. Results indicate that the high-growth scenario is associated with greater interstate linkages, whereas the low-growth scenario leads to more regionally concentrated trade patterns. The magnitude and spatial distribution of these changes differ across product types, reflecting variation in demand and resource availability. The study provides new insights into structural shifts in U.S. wood product markets under alternative economic scenarios and offers a benchmark for assessing market stability, investment decisions, and policy interventions.

Keywords: interstate wood trade, forest products, LURA model, economic growth scenarios, market competition

Summary: This study examines how alternative macroeconomic growth scenarios reshape US interstate wood product trade, affecting market concentration, competitive dynamics, and linkages across major product categories using the LURA model.

Session: 2. Forest Product Industry Structure and Mill Dynamics

Mapping U.S. Forest Product Mills with High-Resolution Imagery and Embeddings

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Recently the U.S. forest products industry has seen an increase in forest product mill closures, which can impact local, regional, and even national timber pricing. Mapping these mills can help forest economists understand and measure forest economic impacts from these closures. However, current mapping methods relying on surveys and direct observations can be costly and time-consuming. In this study, we used freely available high-resolution embeddings and machine learning techniques to detect log yards on or near forest product mill properties. With 175 examples of log yards from 119 forest product mills, our random forest (RF) and multi-layer perceptron (MLP) classifiers each achieved an F1 score of 0.97. After applying the model to the entire U.S., the model detected 975 log yards from the validation dataset and 838 log yards that were not previously recorded in that dataset. Some of these new log yards were later found to be logging decks or trash/recycling yards that had significant log yards. Logistic regression was used to determine if there were any predictive variables for the model's ability to detect a log yard. We found that the existence of a drain pond on the mill property, the dominant log yard species being soft wood, and the average green tons on the mills property for the year were significant predictors of the model's ability to predict the location of a log yard. The results of this work demonstrate the capabilities of freely available, high-resolution embeddings for continuous mill mapping for the U.S.

Keywords: forest product mill, log yard detection, NAIP, machine learning

Summary: In this presentation I will discuss our methodology and results for creating a forest product mill map for the contiguous U.S. states. I will also present on key indicators of model success and how these methods can be repeated for routine updates.

Session: 2. Forest Product Industry Structure and Mill Dynamics

Revisiting the Effects of Internet Usage on Paper Demand with a Focus on e-Commerce and U.S. Paperboard Demand

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The Internet has had a profound effect on the pulp and paper industry. Its earliest impacts were observed in newsprint and graphic paper markets where the traditional positive income elasticity of demand no longer held. In countries with higher levels of Internet adoption GDP growth became associated with accelerated declines in consumption. Earlier research identified this structural shift for newsprint and printing and writing papers but did not find comparable effects in paperboard and packaging grades. Some studies hypothesized that in contrast to communication papers Internet adoption and the rise of e-commerce would generate a positive relationship between GDP and paperboard demand. This expectation was sometimes described as the "Amazon Effect" reflecting the expansion of firms such as Amazon. At the time there was insufficient time series data to test this hypothesis. This study revisits Latta, Plantinga, and Sloggy (2016) using an additional decade of data to reassess these relationships. Consistent with earlier findings we observe a significant negative GDP effect for newsprint. We find no evidence of a sustained "Amazon Effect" in paperboard markets. Instead GDP growth is associated with a similarly negative effect on paperboard demand in recent years. These results suggest that structural changes linked to digitalization extend beyond communication papers and may also be reshaping packaging demand.

Keywords: paper demand, e-commerce, econometrics

Summary: We re-estimate econometrics from a prior study and add a new focus on the relationship between GDP and paperboard demand.

Session: 3. Economic Impacts of Natural Disturbances

Estimating the Social Cost of Carbon Dioxide Incorporating Fire PM2.5 Mortality

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Building upon a new integrated assessment model (GIVE), this study provides preliminary estimates of the partial Social Cost of Carbon Dioxide (SC-CO2) incorporating damages from mortality related to fire fine particulate matter (PM2.5). We develop a damage function that parameterizes key relationships using one of the few studies to predict fire PM2.5 concentrations globally with high resolution. Using simulated fire PM2.5 concentrations from a fully coupled chemistry-climate-land model (CESM), together with global exposure-response functions, we compute associated mortality. We then estimate country-specific relationships between global mean temperature (GMT) change and associated mortality and integrate this damage function into GIVE to compute the partial SC-CO2 for the USA. For an extra ton of CO2 emitted in 2020, our initial estimate for the USA is $6.79, which is larger than damages from the energy, sea-level rise, and agriculture sectors but less than those from temperature-related mortality. Compared to a similar study that estimates higher fire-related mortality in the USA, our resulting partial SC-CO2 is correspondingly lower. Next, we aim to incorporate additional forward-looking studies as a meta-analysis and to complete estimates of the global SC-CO2 including all countries in the GIVE model.

Keywords: social cost of carbon, fire pm2.5 mortality, integrated assessment model

Summary: We estimate a partial Social Cost of Carbon incorporating climate-driven fire PM2.5 mortality. Using CESM and the GIVE model, we link temperature change to wildfire mortality and estimate a U.S. value of $6.79 per ton.

Session: 3. Economic Impacts of Natural Disturbances

From Shock to Recovery: Economic Resilience of Southern Pine Forests Under Natural Disturbance

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Pine plantations are a significant contributor to the Southern US economy, representing about 60% of the total forest harvest. Natural disturbances like fire, hurricanes, and pest outbreaks are major risks leading to huge economic losses, influencing pine forest management decisions. Despite this, there are limited empirical studies connecting the post-disturbance economic recovery trajectories with forest value dynamics and management strategies. This study aims to analyze the rate and drivers of economic recovery in Southern pine forests following natural disturbances under the current forest management strategy. To achieve this, we will use an analytical framework incorporating stand-level growth and yield simulations based on the Forest Vegetation Simulator. The framework will assess economic resilience through four core components: economic resilience metrics, forest value estimation under disturbance risk, optimization for maximizing economic return, and scenario analysis to examine the mechanisms driving recovery. We expect to observe gradual post-disturbance recovery in timber markets, with recovery rates and forest value outcomes sensitive to alternative market conditions and management scenarios. By understanding economic resilience, we aim to offer insights into localized market impacts and recovery dynamics, shaping landowner decision-making and long-term management.

Keywords: disturbance economics, forest management, forest value, optimization, quantifying resilience

Summary: This study analyzes post-disturbance recovery in southern pine plantations to quantify economic resilience through forest value dynamics and management strategies that inform landowner decision-making and long-term forest management.

Session: 3. Economic Impacts of Natural Disturbances

Quantifying Biomass Mortality and Financial Losses from Forest Disturbances in East Texas

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As an extension of the West Gulf Coastal Plain, East Texas frequently experiences large-scale disturbances such as disease and insect outbreaks, wildfires, droughts, and wind events. These disturbances have significant environmental and economic impacts on forest industry. To address gaps in understanding forest mortality trends, this study conducts a comprehensive spatial and economic assessment of biomass loss caused by various disturbances. It focuses on both softwood and hardwood species, covering aboveground and belowground biomass across two regions and 43 counties in East Texas, based on nearly two decades of Forest Inventory and Analysis Program data. From 2006 to 2023, total biomass loss was 179.26 million tons, including 58.30 million tons of softwood and 120.97 million tons of hardwood. Of this, 151.60 million tons were aboveground loss, while 27.66 million tons were belowground. Among all disturbances, weather accounted for the greatest biomass loss, totaling 71.75 million tons, followed by disease at 42.30 million tons. Spatially, most counties experienced an annual increase in biomass loss over time. However, the patterns varied by disturbance type and region. Weather disturbance generally showed a declining trend in annual biomass loss across most counties, whereas disease resulted in a significant annual increase in most counties. The cumulative economic loss reached $3.39 billion over the study period, with $0.96 billion in softwood and $2.43 billion in hardwood loss. The findings offer insights to support industry recovery and provide targeted disaster guidance for various forest stakeholders, improving preparedness and mitigation of future forest-related events.

Keywords: mortality, weather, disease, wildfires, FIA

Summary: The study aims to provide the comprehensive overview of forest mortality across East Texas caused by various disturbances, offering forest landowners, industries, and policymakers a large-scale perspective of disturbance patterns within their regions.

Session: 3. Economic Impacts of Natural Disturbances

Economy-Wide Effects of Hurricane-Induced Forest Sector Disruptions: An Application of a Computable General Equilibrium Model

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The forest industry is a vital component of local economies and the regional economy in the U.S. South. Tree damage and mortality from natural disasters such as pest outbreaks, fire, and hurricanes can negatively affect the regional timber supply, economic returns to landowners, and forest ecosystem services. Following hurricanes and other damaging events, salvage harvesting may allow landowners to recover potential economic losses in the short run. Since hurricanes and subsequent salvage harvests can negatively and positively affect industries within and connected to the forest sector, there is a need to comprehensively assess their economic impacts. Using a computable general equilibrium (CGE) model to assess economy-wide tradeoffs of supply and demand, we estimated the economy-wide impacts of various forest industry labor demand counterfactual simulations using data on salvage harvesting following Hurricane Michael, which damaged over 6 million acres of forestlands in Florida, Georgia, and Alabama. Results from simulated shocks to the forestry and logging, pulp and paper, and primary wood processing sectors highlight heterogenous impacts on both micro- and macro-economic indicators including commodity quantities, gross domestic product, household income, and welfare. The findings from this analysis could be informative for planners, policymakers, and industry professionals on ways to mitigate the negative hurricane impacts in areas where disturbances occur now and in the future.

Keywords: natural disturbance, hurricane michael, labor demand, CGE model, economy-wide impacts

Summary: We will present our approach and share results from a study on the economy-wide impacts from simulated labor market disruptions following Hurricane Michael. We found that results varied by experimental shock and household income level.

Session: 4. From Stand Dynamics to Decision Support: Innovations in Forest Management

Can Loblolly Pine Plantations Remain Financially Viable Under Multi-Objective Management?

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Loblolly pine (Pinus taeda) management in the southern United States is currently facing challenges of escalating establishment costs and depressed timber markets. Simultaneously, escalating global interest in nature-based capital, including carbon markets, wildlife-based recreation, and sustainable land stewardship, has shifted management focus toward optimizing forests for multi-objective returns. Utilizing the Forest Vegetation Simulator (FVS) and Faustmann–Hartman framework, we quantified economic outcomes across site qualities, planting densities, and discount rates when timber, carbon, and wildlife values are strategically combined. Our findings reveal a fundamental shift: integrating ecosystem services doesn't merely improve margins, it transforms marginal sites from net losses to profitable investments. Stacking all three services nearly doubled Land Expectation Value (LEV) on productive sites to $2,981/ha. However, we identify critical trade-offs: silvicultural practices optimized for timber often conflict with requirements for carbon and wildlife habitat. We found that lower-density planting provides higher returns and management flexibility, outperforming traditional high-density regimes, especially in current saturated pulpwood markets. These results provide a strategic insight for southern landowners to mitigate market risks through revenue diversification and adaptive silviculture.

Keywords: ecosystem services; forest landowner; hunting lease; land expectation value; stacking

Summary: This study shows that stacking ecosystem services improves the financial viability of loblolly pine plantations, especially on marginal sites, highlighting trade-offs across profitability, rotation length, and ecosystem service objectives.

Session: 4. From Stand Dynamics to Decision Support: Innovations in Forest Management

From Climate Benefits to Disservices: Reassessing the Role of Urban Forests in Climate Resilience

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Urban forests are widely promoted for their ecosystem services, particularly for enhancing urban climate resilience through cooling, aesthetic improvement, and human well-being. However, considerably less attention has been given to ecosystem disservices, especially under extreme climate events. In regions highly exposed to climate disturbances, neglecting these disservices may weaken public support and reduce policy effectiveness. Taiwan, located in the northwest Pacific Ocean, experiences one of the highest global frequencies of tropical cyclones. Typhoons pose substantial risks to urban forest systems and disproportionately affect residents living near green infrastructure. This study argues that evaluations of urban forests in climate resilience must move beyond benefits and explicitly incorporate disaster-induced disservices. Using survey data from residents of Taichung City, the second-largest city in Taiwan, this study examines public perceptions of urban forest benefits and disservices in the context of typhoon impacts. Results indicate that key perceived benefits include shade provision, scenic value, and stress relief. In contrast, respondents identified notable disservices such as increased maintenance costs, safety hazards from fallen branches and trunks, and infrastructure damage caused by tree roots. Typhoon-related disservices were particularly prominent, including power outages, personal injuries, property losses from falling trees, and increased post-disaster cleanup costs. These findings reveal a critical tension between urban forest benefits and disservices under climate extremes. To enhance climate resilience while maintaining public support, urban forest policies should adopt risk-aware management strategies. Recommended measures include increasing budgets for removing structurally compromised trees, prioritizing wind-resistant species, reinforcing underground utility infrastructure, and expanding preventive pruning programs.

Keywords: urban forests; ecosystem disservices; climate resilience; typhoon disturbances

Summary: Urban forests enhance climate resilience but also create ecosystem disservices under typhoons. Survey results report safety risks, infrastructure damage, and rising maintenance costs, underscoring the need for risk-aware urban forest management.

Session: 4. From Stand Dynamics to Decision Support: Innovations in Forest Management

Forestland Valuation for Current Use Taxation: Income Capitalization Models and an Uneven-Aged Alternative from New Hampshire, USA

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We reviewed statutes, technical documentation, and agency communications and found that income capitalization is the dominant approach for valuing forestland for current use taxation in the United States. Of 30 states using such models, 20 employ forest-based growth and yield inputs, primarily from the USDA Forest Service Forest Inventory & Analysis (FIA) program. Among these 20 states, 16 use sustained-yield formulations that capitalize a single year's income, and 5 use bare-land formulations (one state uses both). States also vary in the treatment of costs (including property taxes), use of real versus nominal values, handling of risk, and procedures for setting capitalization rates. We examine New Hampshire's current use assessment model, highlighting key assumptions and implementation issues relevant to forest taxation policy. Because uneven-aged silviculture dominates management in the U.S. Northeast, we test an alternative formulation that capitalizes cutting-cycle income while retaining a residual stand. Using New Hampshire's model and data as a foundation, we generated assessment values as functions of cutting cycle length and growth performance as well as of constant real stumpage prices, management costs, and capitalization rates. Results were not markedly different from the existing model but better capture the realities of forest management.

Keywords: current use taxation; income capitalization; property tax policy; growth and yield modeling

Summary: We survey U.S. current-use forestland tax models, showing income capitalization dominates and identifying how states differ in growth-and-yield inputs, costs, risk treatment, and capitalization rates.

Session: 4. From Stand Dynamics to Decision Support: Innovations in Forest Management

Retention rules for individual crop trees in northern hardwood forests

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Identification and retention of individual crop trees is central to many silvicultural strategies developed for the production of high-value hardwood timber. The long-term performance of these systems depends critically on the quality of crop tree selection, but quantitative guidance to help inform that selection process is almost entirely absent for managers of northern hardwood forests in the eastern United States. This study presents the results of iterated, simulation-optimization based studies of the financial performance of free-to-grow crop trees of varying initial size, quality, and vigor across seven key commercial species in the region. Retention decisions are framed as a net present value problem in which simulated value trajectories under full release are compared against current stumpage value, less the opportunity costs of delayed regeneration. Performance is evaluated across a factorial of species, sites, discount rates, and timber quality profiles. Results are summarized as simplified field rules structured around diameter thresholds conditioned on crown ratio, timber quality, site, and discount rate. Species identity, diameter, and crown ratio are the dominant drivers of retention potential. Simplified rules achieve approximately 88% classification accuracy and remain stable across realistic variation in economic assumptions.

Keywords: crop tree retention, silvicultural economics, simulation-optimization

Summary: We derive simplified crop tree retention rules for seven key commercial species of northern hardwood forests, with diameter-based retention thresholds conditioned on crown ratio, timber quality, site, and discount rate.

Session: 4. From Stand Dynamics to Decision Support: Innovations in Forest Management

TimberReach: A Geospatial Application for Quantifying Merchantable Timber

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The USDA Forest Service conducts timber sales on National Forests to achieve multiple management goals, ranging from generating economic revenues to delivering environmental benefits, such as reducing fire hazard through timely biomass removal. A Random Forest model of sold and unsold timber offerings is used to generate spatial weights to estimate the relative importance of several physical and economic factors. The weighting strategy will be used in a Multi-Criteria Decision Analysis (MCDA) evaluation to highlight merchantable timber across National Forests in the Southeast and Pacific Northwest. Initial estimates suggest that gross sale area and volume offered may be weighted more heavily than operable slope and bidding method.

Keywords: timber harvests, fuels management, national forest system, machine learning

Summary: Using geospatial and machine learnings methods we are creating a tool called TimberReach, which will highlight merchantable timber on National Forest System lands using physical and economic criteria.

Session: 5. Environmental & Economic Tradeoffs

Assessing Economic and Environmental Impacts of Increasing Log Truck Weight Limits in Texas

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Texas has abundant forest resources, and the forest sector contributes tremendously to the state economy. However, Texas has the lowest log truck weight limits among the neighboring states, which puts the state at a competitive disadvantage in the forest industry. This study examined the economic and environmental impacts of increasing log truck weight limits from 84,000 to 92,000 pounds across these supply chain sectors: forestry, logging, sawmills, and truck transportation. Economic estimation was conducted using IMPLAN with 2023 data, while the environmental impacts were assessed through a survey. Two scenarios, representing 12 and 13 percent efficiency improvements from the increased log truck weight limits, were analyzed using standard truck tare weights. The 12 percent efficiency improvement generated a total of 864 jobs, USD 56.31 million in labor income, USD 90.90 million in value added, and USD 189.91 million in industry output. While the 13 percent efficiency improvement generated a total of 936 jobs, USD 61.01 million in labor income, USD 98.52 million in value added, and USD 205.73 million in industry output. Additionally, the 12 percent and 13 percent efficiency improvements reduced annual fuel consumption by 4.69 million and 5.53 million liters and lowered carbon dioxide emissions by 12.61 thousand and 14.89 thousand tonnes, respectively. These results offer valuable insights for policymakers aiming to improve efficiency and profitability in the timber industry.

Keywords: IMPLAN, forest supply chain, carbon sequestration, truck regulation, social cost of carbon dioxide

Summary: This study evaluates the economic and environmental impacts of increasing log truck weight limits across the forest supply chain. Results show that higher weight limits improve efficiency while reducing fuel consumption and carbon dioxide emissions.

Session: 5. Environmental & Economic Tradeoffs

Containment lines, fuel breaks, PODs and suppression success: A case study of the 2021 Schneider Springs Fire

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Wildfire suppression is shaped by a complex interplay of environmental conditions, resource allocation and management strategies. Examining the containment of the 2021 Schneider Springs Fire in the Eastern Cascades of Washington State, USA, we emphasize critical roles of variable selection, representative sampling and specific factors. Using descriptive, predictive and causal models, we assessed the influence of weather conditions, terrain features, personnel availability, tree canopy cover, fire containment lines, and previously identified 'best available' containment features. High vapor pressure deficit and strong winds were consistently associated with declining containment success. Terrain features such as valleys and ridges facilitated suppression operations, while steep slopes posed challenges. Additional personnel improved containment outcomes, though with diminishing returns in descriptive and predictive models. Tree canopy cover breaks enhanced suppression effectiveness, but with declining utility during windy conditions. Containment lines played a pivotal role, whereas the role of pre-identified containment features was context-dependent, likely influenced by broader strategic decisions. Wildfire containment was influenced by multiple variables, and suppression strategies were situationally determined. Causal models provided valuable insights by isolating total effects of primary variables. Findings underscore adaptive fire management strategies that incorporate context-specific information. Future research should integrate fine-scale weather metrics and additional fire behavior drivers that guide effective decision-making during dynamic operations.

Keywords: wildfire suppression, risk management, climate impacts

Summary: We assessed the influence of weather conditions, terrain features, personnel availability, tree canopy cover, fire containment lines, and previously identified 'best available' containment features.

Session: 5. Environmental & Economic Tradeoffs

Economic Valuation of Air Quality and Health Implications from Woody Biomass Electricity under Clean-Energy Portfolio Pathways in Arizona, Colorado, and New Mexico

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State-level clean-energy transitions are reshaping electricity portfolios across the western United States, yet the air-quality consequences of integrating woody biomass electricity remain strongly dependent on deployment context. This study evaluates how alternative clean-energy portfolio designs influence air pollution and health outcomes when woody biomass electricity is introduced under policy-relevant pathways in Arizona, Colorado, and New Mexico.
We examine two analytically distinct biomass deployment pathways. In the fossil-displacement pathway, woody biomass electricity substitutes for fossil-fuel generation, reflecting decarbonization strategies in which higher-emission combustion sources are reduced. In the renewable-competition pathway, biomass competes with non-combustion renewable resources (wind, solar, and hydro), representing portfolio allocation dynamics under renewable or clean-energy mandates. Within each target year, fossil-fuel generation is held constant across scenarios to isolate substitution effects. Changes in $PM_{2.5}$ and ozone concentrations are estimated using the EPA's COBRA screening model. Modeled concentration differences are translated into premature mortality impacts using BenMAP-CE, applying established concentration–response relationships and baseline incidence rates. Economic valuation techniques may then provide a monetary value across various scenarios. Scenario design spans biomass penetration levels and policy-relevant target years. Results highlight that air-quality and health outcomes of woody biomass electricity depend on replacement context. Biomass substitution for fossil-fuel generation yields different pollutant and health responses than substitution among non-combustion renewable resources. By linking electricity portfolio design, air-quality modeling, and health assessment, this work clarifies environmental tradeoffs of woody biomass within evolving clean-energy systems. Findings provide insight for policymakers and resource managers navigating decarbonization strategies, forest biomass utilization, and public-health objectives.

Keywords: air quality models, economic valuation models, heath assessment, woody biomass utilization, renewable portfolio scenarios

Summary: This project highlights methodology that allows policy makers and resource managers the ability to determine and monetize air and human health impacts of various renewable energy standards as they interact with neighboring states.

Session: 5. Environmental & Economic Tradeoffs

Natural versus Artificial Christmas Trees: An Integrated Economic and Environmental Assessment in the United States

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Christmas trees are an important holiday tradition across the U.S., yet each holiday season, there is ongoing discussion about the relative sustainability of natural and artificial Christmas trees. To address this question, this study evaluated the economic and environmental performance of both industries in the U.S. from 2004 to 2024. The study estimated carbon emissions associated with each Christmas tree industry at the national, regional, and state levels across life cycle stages. In addition, it developed economic and environmental ratios to directly compare economic contributions and carbon emissions between the two industries. Economic contributions were estimated using an input-output model, while environmental impacts were assessed using life cycle assessment approaches. The results indicate that between 2004 and 2024, direct industry output from natural Christmas trees declined from USD 15.36 billion to USD 9.28 billion, while output from artificial Christmas trees increased from USD 12.60 billion to USD 27.87 billion. Over the same period, CO_2 emissions from natural trees increased from 96.10 to 107.83 thousand tonnes, whereas emissions from artificial trees rose sharply from 161.20 to 582.11 thousand tonnes. In 2024, artificial Christmas trees generated substantially higher CO_2 emissions than natural trees across all U.S. regions and states. The economic ratio increased from 0.82 to 3.00, while the environmental ratio rose from 1.68 to 5.40 over the study period. These findings enable policymakers, industry stakeholders, and consumers to better evaluate the economic contributions and carbon implications of Christmas tree consumption across the U.S.

Keywords: IMPLAN, economic contribution, carbon emissions, life cycle assessment, regional analysis

Summary: This study compares economic and environmental performance of natural and artificial Christmas trees industries in the U.S. While both industries contribute to nation's economy, artificial trees generate substantially higher carbondioxide emissions.

Session: 5. Environmental & Economic Tradeoffs

Quantifying the Economic Impact of Value-Added Processing Retention in Mississippi

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This research develops a framework for quantifying the economic development potential of retaining value-added processing activities within resource-dependent regional economies. While many rural regions successfully produce agricultural and forestry commodities, a substantial share of these outputs are exported as intermediate inputs for processing that occurs elsewhere, representing foregone income, employment, and multiplier effects. This research addresses a critical gap in the regional economics literature by systematically integrating entrepreneurial opportunity identification with quantitative economic impact assessment. Preliminary analysis for Mississippi reveals that 74% of production ($19.85 billion) is exported out-of-state, with 53% of these exports ($10.59 billion) purchased as intermediate inputs for further processing rather than final consumption. This processing leakage pattern suggests significant untapped economic development opportunities where demand for processing exists but the associated manufacturing activity is geographically displaced. Preliminary analysis identifies 19 high-opportunity commodities accounting for approximately $7.2 billion in processing leakage, concentrated in forest products, oilseeds, soybean and other oilseed processing, flavoring syrup and concentrate, finished textiles and fabrics, grains, beef cattle, other animal food, and cotton textiles. This research extends standard regional input-output modeling through counterfactual scenario analysis accounting for regional purchase coefficient adjustments and structural change, and integrates feasibility analysis examining minimum efficient scale, capital requirements, labor availability, and market access constraints. Unlike previous studies, this work provides comprehensive sector-wide analysis linking opportunity identification to quantified economic impacts, with direct policy relevance for informing strategic allocation of financial incentives, infrastructure investments, workforce training, and regulatory reforms—designed to be replicable across other states and sectors.

Keywords: regional economics, input-output analysis, value-added processing, economic development, import substitution

Summary: This research quantifies $10.6 billion in processing leakage from Mississippi's $26.8 billion agricultural and forestry sector, identifying 19 high-opportunity commodities worth $7.2 billion to guide economic development policy.

Session: 6. Forest-Based Climate Mitigation

A Time-Dependent Global Warming Mitigation Analysis of U.S. Private Forests by Region and Site Productivity Class: Forest Growth, Wood Products, and Residue Bioenergy

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Forests and harvested wood products (HWPs) shape climate outcomes through time-dependent carbon uptake, storage, and delayed emissions across forests, products, residues, and end-of-life pathways. We quantify the global warming mitigation potential (GWMP) of U.S. private forests over a 100-year horizon using a dynamic radiative forcing framework parameterized with FIA-based growth, mortality, and harvest flows and region-specific HWP allocation, product lifetimes, landfill methane, and supply-chain emissions. Results are computed at the state level and aggregated to six U.S. regions, with additional stratification by seven site productivity classes. We compare (1) net forest growth, (2) forest + HWPs (excluding substitution), and (3) full-system outcomes including material and energy substitution. Baseline mitigation varies sharply across regions and productivity classes: regional mean forest-only mitigation ranges from near-neutral in the Rocky Mountains (~0.04 t CO_2e ac^{-1} yr^{-1}) to ~2.03 t CO_2e ac^{-1} yr^{-1} in the Southeast. Adding HWPs increases mitigation modestly, while including substitution can shift regional rankings and raises full-system mitigation to ~0.13–3.18 t CO_2e ac^{-1} yr^{-1}. To evaluate the effect of increasing harvest residue utilization, we vary allocation of above-stump harvest residues among retention/decay, on-site burning, and bioenergy (30–50% diversion from burning) under a range of displacement factors. Increasing residue-to-bioenergy allocation yields approximately linear gains, with national-scale increases of ~5.8–46.0 million t CO_2e over 100 years, concentrated in high-harvest strata and when bioenergy displaces more carbon-intensive energy. These results identify where residue markets and substitution assumptions most influence climate benefits and inform resilient forest-sector strategies.

Keywords: global warming mitigation, harvested wood products, forest residue bioenergy utilization, substitution

Summary: 100-year mitigation estimates for U.S. private forests by region and site class, including wood products, substitution, and residue-to-bioenergy. Results show where residue utilization and displacement factors most influence mitigation.

Session: 6. Forest-Based Climate Mitigation

Carbon Benefits of Wood Use Over Time: Energy and Residential Construction in the United States

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The United States (U.S.) is the largest producer of industrial roundwood. Although long-lived wood products primarily drive economic value in the forest products sector, woody biomass also serves as a significant renewable energy source. Expanding wood utilization is considered a strategy for mitigating carbon emissions, as sustainably managed forests can provide a continuous supply of harvested wood products as well as woody biomass for energy. The main objective of this study was to analyze the avoided carbon emissions benefits from wood use over time, both as an energy source and a construction material for residential buildings. Since characterization of wood use would make a basis for the estimation of carbon emissions avoided, a comprehensive analysis of the wood used over time, both for energy and residential construction was carried out. National statistics were used to compile annual data from 1949 to 2024 on wood use quantities for energy and single and multifamily houses constructed. A life cycle assessment approach was applied to quantify greenhouse gas (GHG) emissions from wood use for energy and products, as well as the carbon benefits associated with displacing non-wood alternatives. The findings of the study are intended to support U.S. forest sustainability reporting efforts, such as the Montréal Process Criteria 5 and its indicators.

Keywords: wood products, woody biomass, energy uses, residential construction, carbon benefits

Summary: This presentation would focus on providing a comprehensive overview of historical wood use, including the avoided carbon emissions benefits from wood use over time, both as an energy source and a construction material for residential buildings.

Session: 6. Forest-Based Climate Mitigation

Optimal Extension of Rotation for Forest Carbon Credits

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Improved forest management (IFM) carbon credits often rely on extending harvest rotations beyond profit-maximizing timber management, albeit the size of these extensions is imposed exogenously by carbon protocols rather than derived from economic optimization. This paper develops a theoretical framework for optimal rotation extension when the economic value of forest carbon credits is explicitly valued. Using the Faustmann rotation as the baseline, the conditions are characterized under which the optimal carbon rotation converges to the biological rotation, exceeds it, or becomes unbounded. The value of carbon credits is maximized when the marginal benefit of net carbon sequestration equals the opportunity cost of forgone carbon rent from future rotations. This framework nests the Faustmann and biological rotations as special cases and offers a geometric interpretation linking optimal rotation theory to carbon credit accounting. Numerical simulations based on a Chapman-Richards growth model calibrated to loblolly pine plantations show that when growth is monotonic and mortality is ignored, the optimal carbon rotation is unbounded. Introducing stand-level mortality yields a finite optimum: the economically optimal carbon rotation extends roughly 55 years beyond the Faustmann baseline and exceeds both the Faustmann and biological rotations, even as mean annual increment declines. Sensitivity analysis indicates that optimal extensions are most responsive to the discount rate, harvest release factor, and growth dynamics, with plausible extensions ranging from 35 to 85 years. These findings highlight the limitations of fixed, protocol-specified rotation extensions and underscore the need for endogenous, model-consistent benchmarks in IFM carbon programs.

Keywords: climate finance, decision-making, natural capital, timberland investment

Summary: This paper develops a theoretical framework for optimal rotation extension for forest carbon credits.The optimal condition is when marginal benefit of net carbon sequestration equals opportunity cost of foregone carbon rent.

Session: 6. Forest-Based Climate Mitigation

The Hidden Cost of Pile Burns: Accounting for the Carbon Cost of Forest Management

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Slash pile burning is a widely employed forest management strategy to limit surface fuels, but it can produce significant greenhouse gas and particulate emissions, with unpriced external costs. While some research has explored localized impacts, no national-scale emission estimates exist for slash pile burning across US National Forests. We analyze pile burns from 45 US National Forests representing roughly 60% of the National Forest System land area, over the period 2020-2024, estimating CO2, methane (CH4), and PM2.5 emissions. Depending on the assumed consumption factor, we estimate between 1.4-12.5 million tons of CO2 equivalent emissions and 6,900-62,000 tons of PM2.5 emissions over this period. These greenhouse gas emissions translate to a social cost of between $265 million to $2.4 billion with an assumed social cost of CO2 of $190 per ton. These results indicate that slash pile burning reduces the climate-regulation services provided by forests and that the welfare losses associated with this reduction can exceed those accounted for in current management decisions. Incorporating these ecosystem service losses could incentivize alternative residue removal strategies with lower environmental impacts.

Keywords: slash piles, greenhouse gases, land management, particular matter, ecosystem services

Summary: National-scale analysis of slash pile burning across U.S. National Forests, estimating CO2, CH4, and PM2.5 emissions and monetizing climate damages using the social cost of carbon, highlighting the welfare costs of accelerating carbon release.

Session: 7. Economic and Social Dimensions of Wildfire Management

Do Higher Wages Improve Wildland Firefighter Workforce Retention?

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Federal agencies require a consistent workforce to fight fires throughout the United States. However, the Forest Service continues to face challenges in retaining firefighters. At the same time, fire seasons have become longer and more intense, necessitating a more experienced workforce. One proposed reason is that wages are too low to retain skilled workers, but this has not been directly tested. We examine this question using annual wage data obtained via the Freedom of Information Act from the US Office of Personnel Management for a large share of federal firefighters in the United States. We use a Cox Proportional Hazard model to estimate how wages and experience affect the risk of workforce departure. We find that firefighters are more likely to leave federal agencies as the gap between their wages and those of competing occupations widens. However, this effect is smaller for firefighters with more than four years of experience. These results suggest that both competitive compensation and job-specific experience are critical determinants of retention in federal wildland firefighting.

Keywords: firefighter, workforce, retention

Summary: Econometric analysis of wildland firefighter retention

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Session: 7. Economic and Social Dimensions of Wildfire Management

Economic Costs of U.S. Wildfires: A Meta-Analysis

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Wildfires in the U.S. are increasing in size, severity, and frequency, leading to a wildfire crisis where at-risk communities are experiencing rapidly escalating wildfire damages. This wildfire crisis necessitates resilience efforts that facilitate learning how to adapt to evolving natural disasters and help mitigate the economic costs of wildfire. Better understanding of the extent and type of economic costs, along with trends over time, can provide valuable information for avoiding or reducing total wildfire damages. To evaluate wildfire costs, we conducted a meta-analysis of documented costs in the peer-reviewed and gray literature. We classified 127 individual wildfire costs from 28 wildfires into nine categories: Suppression, Evacuation; Structures & Contents; Structure-Related; Infrastructure; Mortality & Morbidity; Market Impacts; Ecosystem Services; and Rehabilitation. We found that wildfire cost categories contribute to total costs at different rates, with economic costs being greatest for Structures & Contents and Suppression, followed by Ecosystem Service costs. Our results show that wildfire costs have been increasing over the last two decades and human-ignitions are contributing to greater costs. Post-wildfire flooding costs, when present, represent a secondary natural disaster and tend to be greater than wildfire costs themselves. Overall, wildfire costs are poorly documented, leading to incomplete reporting of wildfire cost types. When costs are documented, they are often underestimated.

Keywords: wildfire costs, wildfire damages, meta-analysis, post-wildfire flooding, ecosystem services

Summary: The paucity of wildfire cost data, combined with increasing wildfire severity, generates a need for a synthesis and accounting of the published wildfire cost information. I will present our research hypothesis, methods, and meta-regression results.

Session: 7. Economic and Social Dimensions of Wildfire Management

Relaxing Budget Constraints and Wildfire Suppression: Evidence from the Fire Funding Fix

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Wildfire suppression expenditures in the United States have risen sharply, creating growing fiscal pressure. This work in progress studies the Fire Funding Fix (FFF), a 2018 reform that introduced disaster-style financing for wildfire suppression and relaxed binding budget constraints. We use incident-level daily data on U.S. wildfires from 2014 to 2023 to examine how the reform affected suppression behavior and spending. Preliminary evidence indicates that the FFF increased peak resource use and changed the relationship between fire size and suppression expenditures, with little change in average cost efficiency. The estimated effects are concentrated in a small number of extreme, high-cost fires rather than typical wildfire incidents.

Keywords: wildfire suppression costs, climate disasters, disaster finance

Summary: This presentation introduces a work-in-progress of the Fire Funding Fix. It discusses how relaxing federal budget constraints may have changed suppression behavior and/or spending, and seeks feedback on identification, mechanisms, and interpretation.

Session: 7. Economic and Social Dimensions of Wildfire Management

Understanding Fuels Treatment Acceptability Across the West: Evidence from the Wildfire Research (WiRē) Compiled Dataset

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As agencies implement fuels treatments on public lands to address the wildfire crisis, public acceptance of those treatments is a critical factor in implementation. Lack of support can lead to project alterations, delays, or even abandonment. This talk synthesizes findings from studies leveraging the Wildfire Research (WiRē) compiled dataset, a novel cross-community dataset that pairs household survey responses with parcel-level wildfire risk assessment data spanning numerous wildland–urban interface (WUI) communities across the Western United States. The unique dataset allows for generalizable cross-community insights while paying careful attention to local variation. First, across thirteen Western communities, we find broad public support for common fuels treatments, including thinning, fuel breaks, and pile burning. However, acceptance varies meaningfully by treatment type and location, highlighting that while support is high overall, the "devil is in the details." Second, we investigate how trust in information sources shapes acceptability. Information perceived as useful, particularly from local, trusted sources, is positively associated with treatment support, while less-trusted or less-useful sources can dampen acceptance. These findings underscore the importance of aligning agency communication with trusted local partners. Finally, a case study from Alaska's Kenai Peninsula demonstrates how proximity to public lands and risk perceptions relate to treatment support. We find no evidence of NIMBY attitudes and identify YIMBY support for thinning, suggesting that perceived vegetation conditions on public lands, rather than distance alone, shape acceptance. Together, these studies demonstrate the power of standardized, multi-community data to reveal both broad patterns and place-based nuance in fuels treatment acceptability.

Keywords: acceptability, fuels treatments, public lands, wildfire
Summary: This presentation synthesizes research on public acceptability of fuels treatments in the WUI using the Wildfire Research (WiRē) dataset. Findings show broad but nuanced support and explore some factors related to acceptance.

Session: 7. Economic and Social Dimensions of Wildfire Management

Working Watersheds in Colorado (holistic approach to restoring a sustainable timber industry)

John Giordanengo, President, Economic Restoration Insitute (*john@economicrestoration.org*)

Pondering our social, economic, and environmental needs, our first sensation is often conflict. But the more we dig, a different reality materializes. John Giordanengo of the Economic Restoration Institute will share details of the new "working watersheds" program in Colorado, and how local businesses have the power to turn a fire-prone forest into a source of renewable energy, jobs, clean water, and wood products. That is, watersheds that work well ecologically and economically. Many Colorado forests have suffered from nearly two centuries of fire suppression. Halting this natural process, the severity and scale of modern wildfires has become amplified. Meanwhile, the forest and timber products industry has suffered great losses—few businesses remain to manage our forests sustainably. Herein lies the opportunity. Thinning overly-dense forests provides a wide range of direct environmental and economic benefits. Indirect benefits also result, like increased biodiversity, increased forage for free-range cattle, water quality, and increased resilience in the face of climate change. This talk melds ecological and economic principles to reveal a logic model for economic drivers of watershed restoration, and the productive balance between nature, economy, and humanity. A few restorative policy tools will also be shared, to help restore our capacity to sustainably mange Colorado forests. Rather than earth's economies being at odds with its ecosystems, might their fates in fact be intertwined, with the health of one hinging upon the health of the other.

Keywords: economics, systems thinking, policy, trade, renewable energy

Summary: Summary of the theory, policies, and history behind Working Watersheds, a state-wide program to restore Colorado's timber and forest products industry to a sustainable state.

Session: 8. Lightning Session

An Economic Model of Hardwood Management and Markets in the Southern Appalachian Region (SAR)

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Jesse D. Henderson, Research Economist, USDA Forest Service, Southern Research Station

Forest landscapes in the southern Appalachian region (SAR) are characterized by dominance of mixed-species hardwood stands, with (i) a niche market for high-value products such as barrels and veneer, (ii) a prevailing "hands-off" management paradigm that often occurs as high-grading and diameter-limit cutting, (iii) rarity of silvicultural practices such as improvement cuts, (iv) a virtual absence of viable outlets for low-value, small-diameter roundwood, and (v) mesophication of historically oak-dominated stands. As such, existing regional, national, and global forest sector models do not adequately represent the management nuances of structurally and compositionally diverse hardwood forests, the importance of niche and emerging forest product markets, or the ecological outcomes associated with existing or alternative management pathways. To that end, we develop an intertemporal optimization model of forest management and markets for SAR hardwood systems. Using Forest Inventory and Analysis (FIA) data, we simulate 9,695 hardwood stands in Forest Vegetation Simulator (FVS) over a 50-year horizon under four management regimes: no management, diameter-limit cutting, high-grading, and midstory removal targeting oak competitors. We then implement a linear programming formulation in General Algebraic Modeling System (GAMS) that integrates FVS-derived growth-and-yield trajectories to determine (i) the optimal selection of management regimes, (ii) optimal harvest timing and volume, and (iii) area allocation to management regimes across stands, to maximize net present value subject to land-balance constraints. Results from this study provide a landscape-scale economic characterization of widespread management regimes (no management, high-grading, and diameter-limit cutting) and evaluate the potential economic viability of biochar-oriented utilization pathways associated with midstory removal of small-diameter trees competing with oaks.

Keywords: hardwood, Appalachian region, forest management, markets, harvest scheduling model

Summary: We present a simple economic modeling framework, illustrating the optimal selection of management regimes (a mix of exploitative and improved practices), management timing, and area allocation in a relatively complex hardwood forest setting.

Session: 8. Lightning Session

Balancing Risk and Management: The Evolution of Liability Rules and Management Requirements in Prescribed Fire Legislation

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Gregory E. Frey, Research Forester, USDA Forest Service
Xiaofei Li, Associate Professor, Mississippi State University

Over recent decades, wildland fire has become increasingly frequent and severe across U.S. forestlands, prompting persistent attention to prescribed fires as an essential tool for reducing fuel loads, along with other benefits. Because prescribed fires entail inherent risks such as smoke emissions and potential escapes, extensive legal reforms have been undertaken since the 1990s to clarify management responsibilities and liability rules. In this study, 171 state bills and seven federal bills from 1988 to 2025 related to prescribed fire governance were identified. The dynamic evolution of legislative efforts was revealed through content analysis and regression modeling. The findings demonstrated clear geographic and temporal patterns, with early adoption concentrated in the South and diffusion to other regions over time. Comprehensive legislative approaches combining ex-ante management requirements with ex-post liability protections were most successful. Legislative outcomes were influenced more by socioeconomic and institutional capacity than by wildfire severity, with bills originating in higher-income states more likely to pass. These findings underscore the potential of balanced, incremental, and regionally adaptive approaches to legislation that expand the use of prescribed fire as a land management practice.

Keywords: binary logit model, negligence, prescribed burning, tort liability, wildfire

Summary: A total of 178 bills for prescribed fire were identified. Early legislation emerged in the South and diffused nationwide. Bills with both management and liability requirements were most successful.

Session: 8. Lightning Session

Economic contribution of Forest Product Industries: A county-level analysis

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Most of the studies related to the economic contribution of Forest Product Industries are conducted at the state level, which provides information on employment and income supported by the sector. Although important, these state-level analyses overlook regional relationships between the various industries. Sub-state level analysis can be especially important in Texas, where approximately one-third of Texas is covered by forest, and timberland is concentrated in the eastern region, which is in proximity to urban centers. Moreover, the state has been facing rapid population growth and urbanization. This study aims to examine and compare the county-level direct economic contributions of Forest Product Industries over the last few years and explore their relationship with existing forest resources and socio-demographic factors. The results identify counties that contributed most to local economies by supplying raw materials and/or manufacturing forest products; identify any drastic changes associated with rapid changes in socio-demographic factors; and understand the relationship between economic contribution, existing forest resources, and socio-demographic factors. The findings will help the public better understand the role of the forest product industries in local economies and their relation to forest resources and socio-demographic factors. This can help managers and policy makers determine priority areas and programs for forest management and the forest product industries to sustain the future of forests.

Keywords: input-output analysis, labor income, logging, primary solid wood, pulp and paper

Summary: This presentation analyzes the county-level direct economic contributions of Texas forest product industries, revealing top-contributing counties and changes driven by socio-economic factors.

Session: 8. Lightning Session

Evaluating the Economic Consequences of Chronic Wasting Disease Using Hunter Survey Data: Behavioral Responses and Regional Market Shocks Using IMPLAN

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Neelam Poudyal, Professor, School of Natural Resources, University of Tennessee
Ram Adhikari, Assistant Professor, Department of Forestry, Mississippi State University
Kevin Hunt, Sharp Professor of Human Dimensions, Department of Wildlife, Fisheries, and Aquaculture, Mississippi State University
Lisa Muller, Professor and Assistant Director, School of Natural Resources, University of Tennessee
Robert Grala, Professor, Department of Forestry, Mississippi State University
Sushma Bhattarai, Postdoctoral Associate, Department of Forestry, Mississippi State University

This study quantifies the potential economic impacts of chronic wasting disease (CWD) in Mississippi and Tennessee. Integrating hunter survey data with regional input–output modeling, we estimate expected changes in trip-related expenditures under increasingly severe hypothetical CWD prevalence scenarios (10% to 100%). By treating reported reductions in hunting participation as demand-side shocks, we project the resulting impacts on regional output and employment. Our findings reveal a substantial impact as disease prevalence increases and economic contraction follows. Estimated reductions in hunting-related expenditures range from 14.6% to 59.0% in Mississippi and 11.6% to 38.0% in Tennessee. The most acute employment losses are concentrated in the sporting goods, food and beverage, gasoline, and hospitality sectors. While the existing literature suggests that hunting effort may remain resilient at low prevalence levels, our results highlight the massive scale of short-term fiscal volatility associated with advanced CWD outbreaks. Ultimately, this research underscores the necessity of incorporating human behavioral dynamics into wildlife disease management. By identifying the specific sectors most vulnerable to CWD-induced shifts in consumer behavior, this study provides policymakers with a framework to evaluate the broader socioeconomic resilience of forest-dependent rural economies.

Keywords: Chronic Wasting Disease (CWD), Multi-Regional Input-Output (MRIO), human dimensions of wildlife, hunter behavior, economic resilience

Summary: The economic impact of chronic wasting disease in Mississippi and Tennessee is modeled integrating hunter behavior with input-output analysis.

Session: 8. Lightning Session

Insurance Pricing Responds Asymmetrically to Wildfire Risk and Mitigation in Colorado

Srijana Baral, Assistant Professor, Colorado State University (*Srijana.Baral@colostate.edu*)
Mahesha Kuluppuarachchi, Post-doctoral Researcher, Colorado State University
Kritagya Gyawali, PhD Student, Colorado State University

Escalating wildfires across the western United States have intensified pressure on homeowners' insurance markets, yet little empirical evidence exists on how wildfire risk and mitigation are incorporated into premium-setting decisions. Using panel data for Colorado from 2018 to 2022 (n = 404), we examine how wildfire exposure, mitigation actions, and insurance market indicators influence homeowners' insurance premiums across high and low wildfire risk zones. Premiums increase systematically with wildfire exposure and exhibit temporal persistence, indicating that insurers update prices primarily in response to realized hazard and past pricing trajectories. In contrast, we find no evidence that federal, state, and local wildfire mitigation activities are reflected in premium pricing, suggesting the opacity of insurance pricing mechanisms that govern how risk-reduction information is incorporated into premiums. Together, these findings reveal a structural disconnect between physical risk reduction and actuarial pricing, indicating that insurance markets may amplify climate vulnerability rather than facilitate adaptation. As a result, current pricing structures may weaken incentives for household adaptation and contribute to continued vulnerability in wildfire-prone areas.

Keywords: wildfire risk, home insurance, risk management, risk transfer, home vulnerability

Summary: This presentation will highlight factors influencing home insurance premiums across wildfire risk zones.

Session: 8. Lightning Session

Opportunities and Impacts of Market Expansion to Utilize Wood Fiber for Biopower in the United States

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U.S. forests are accumulating underutilized biomass because growth exceeds removals, markets are declining, wildfire risks are increasing, forest health issues persist, and economic efficiencies are lacking. Emerging wood-fiber markets, such as biomass bioenergy with carbon capture and mass timber, can enhance forest resilience and support decarbonization efforts. This study employs dynamic, recursive forest-sector models to evaluate how demand shocks influence feedstock use, facility siting, trade, and market equilibrium. The models incorporate spatial timber supply, mill capacity, transportation costs, and price responses across various economic scenarios. Four case studies nationwide demonstrate the availability of resources to support emerging markets with appropriate infrastructure and policies. In Michigan, biopower combined with BECCS could generate markets for 680,000 tons of biomass, providing carbon benefits and funding for forest management, an essential step for controlling invasive species and diseases. In Louisiana, large biopower plants with BECCS could raise biomass use by 10.6 million green tons from 2025 to 2028, stimulating economic activity and reshaping supply chains. These emerging wood markets can foster economic growth, expand residue markets, and support active forest management. Increased demand for wood fiber benefits rural economies by creating jobs and increasing landowner revenues, all while supporting climate objectives. Well placed facilities have the potential to expand markets for underutilized wood fiber and strengthen the resilience of the forest sector.

Keywords: bioenergy, carbon capture, energy security, feedstock costs, resource allocation

Summary: Market development for biomass bioenergy with carbon capture can enhance forest resilience, support decarbonization, and boost economic growth via increased demand, infrastructure, and rural jobs.

Session: 8. Lightning Session

Re-Evaluating Selection Thinning

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Robert York, Associate Professor of Cooperative Extension, University of California, Berkeley

An analytical illustration of the economic logic of selection versus low thinning was presented in 2025 at the Western Forest Economists (WFE) meeting. This lightning talk provides a follow up to that presentation, reporting on preliminary empirical results from the field trial that was the motivation for that theoretical work. The trial was established in 2016 in a 40-year-old planted Sierra mixed-conifer stand to compare its growth response to different thinning methods. This talk will briefly review the analytical reasoning developed to illustrate the general logic of that problem. Then, as demanded by disappointed WFE attendees in Seattle last year, results from an inventory conducted in the summer of 2025 will be presented alongside FVS projections of future stand growth and economic performance.

Keywords: sierra mixed-conifer, silvicultural economics, thinning

Summary: Preliminary results from a 2016 field trial comparing thinning methods in a Sierra mixed-conifer are presented alongside projected future stand growth, following up on theoretical work on the economic logic of thinning presented at WFE 2025.

Session: 8. Lightning Session

Comparing Economic Valuation Methods between Biopower and Other Renewable Energy Generation Technologies

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Ram Dahal, Wisconsin Department of Natural Resources
Robert Idel, Independent Power Market Researcher
Omkar Joshi, Oklahoma State University,
Sharon Klein, The University of Maine
Larry Leefers, Michigan State University
Thomas Ochuodho, University of Kentucky
Rajan Parajuli, North Carolina State University
Chris Saffron, Michigan State University
Govinda Timilsina, Development Research Group, The World Bank
John Wagner, SUNY College of Environmental Sciences and Forestry

Energy system decision-makers need to be able to evaluate the economic impacts of different energy generation options in multiple sectors in an economy. While different approaches exist to compare these economic impacts and valuations, past studies have typically relied on only one or a few methods. This article summarizes the output of multiple complementary approaches, including 3-4 pages of written responses from each participant, discussion from a one-day workshop attended by economists specializing in natural resources, energy, and agriculture, as well as presentations and ongoing communication among participants. Participants examined the advantages and limitations of various economic evaluation methods. This paper summarizes the pros and cons of several key economic valuation methods and recommends using a combination of different valuation methods which provides a more complete assessment across the energy production sectors. The focus of the study is to develop a framework to better account for biopower when comparing electricity generation technologies. Discussions revealed that each energy sector employs distinct methodologies and valuation techniques, each with its own strengths and weaknesses. While various methods can be applied across different energy sectors, they do not always capture the full picture or the unique economic benefits of each one. These results will help economists and policymakers in understanding the uniqueness of various valuation methods and utilize multiple approaches for standardized, comparable, holistic, and robust economic valuation and impact assessment methods to compare biopower and other renewable energy generation technologies.

Keywords: discounted cash flow, generalized equilibrium model, input-output model, levelized cost of electricity, multi-criteria decision, life cycle analysis, technoeconomic analysis
Summary: This presentation summarizes the pros and cons of several key economic valuation methods and recommends using a combination of methods to provide a more comprehensive assessment across energy production sectors.

Session: 9. Private Forest Landowners: Behavior, Adoption, and Policy Engagement

Adoption, Intensity, and Exit: An Analysis of Sustainable Forest Management in West Virginia

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Sustainable Forest Management (SFM) plays a critical role in meeting the objectives of private forest landowners while also advancing broader environmental and societal goals. Forests comprise 78% of West Virginia's land area, signaling that broader SFM adoption could substantially enhance climate resilience and ecosystem services. Yet most empirical studies explore a limited range of practices and frequently conceptualize SFM as a binary choice, thereby neglecting the intensity and mix of practices that influence long-term ecological and economic outcomes. This study investigates the factors influencing both SFMPs adoption and intensification among family forest owners. We analyzed 223 responses from an online survey and employed a multivariate probit and generalized logit models to determine the factors affecting the adoption and intensity of adoption of SFMPs. The findings show that positive perceptions of ecological co-benefits increase adoption and management intensity. Additionally, familiarity with carbon programs, household income, landowner experience, and private information networks significantly influence adoption and intensity. Conversely, larger parcel size and greater proximity from forest properties are associated with reduced intensive adoption. The joint modeling of extensive and intensive margins yields new evidence regarding private forest owners' responses to changing market conditions and environmental risks. The results indicate that policies emphasizing only initial adoption are likely insufficient. Sustained participation is influenced by access to knowledge, recognition of ecosystem benefits, and adaptive capacity. These findings advance forest resource economics by identifying strategies to enhance resilience and promote sustainable management of privately owned forests in the United States.

Keywords: sustainable forest management, adoption intensity, private forest landowners, ecosystem co-benefits, forest resilience, multivariate probit, generalized ordered logit

Summary: This study investigates the adoption, intensity, and exit of sustainable forest management practices (SFMPs) in West Virginia. Findings indicate that ecological values are key drivers of adoption. The results provide insights for intensifying SFMPs.

Session: 9. Private Forest Landowners: Behavior, Adoption, and Policy Engagement

Examining Landowner Acceptance of Carbon-Based Improved Forest Management in the Marginal Lands of Oklahoma

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Omkar Joshi, Professor, Oklahoma State University

Natural resources are being influenced by a shift in overall climate, and utilizing improved management options will be necessary to prevent further damage. Forests offer significant carbon storage opportunities and function as a global climate mitigation option. A survey was produced to obtain knowledge of landowner acceptance of carbon-based improved forest management in the marginal lands of Oklahoma. The results displayed that almost 24% of landowners were willing to be involved in a carbon-based forestry program. The concerns of landowners were also recorded, and about 51% were very concerned about losing their independence to manage their own property. Carbon market policies were also significant for many, with around 72% of participants indicating concern about policy change. Younger and female respondents were more likely to have these policy concerns than other groups. The results from this study highlight the need for future outreach and educational opportunities surrounding the topics of carbon and improved forest management for private landowners. The implementation of educational opportunities will enhance the creation and implementation of programs emphasizing management in marginal lands and improve overall program success.

Keywords: landowners, carbon, forestry

Summary: A survey was produced to obtain knowledge of landowner acceptance of carbon-based improved forest management in the marginal lands of Oklahoma. Study results show 24% acceptance and need for further outreach among private landowners.

Session: 9. Private Forest Landowners: Behavior, Adoption, and Policy Engagement

Forest Landowner Carbon Market Participation as a Response to Concerns about Property Taxation: Does a Relationship Exist at the State Level?

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Taxation has a significant influence on family forest landowner decision-making, as property taxes affect forest management activities and long-run financial returns. Since the 1960s, preferential property tax programs in many states have aimed to reduce holding-cost burdens, and more recently, private carbon incentive programs have emerged to compensate landowners for carbon sequestration through extended management commitments. While both programs can increase expected returns, enrollment remains limited, often attributed to awareness gaps and administrative complexity. This study uses 2019–2021 National Woodland Owner Survey data aggregated at the state level to examine whether concern over property taxation (CNCTAX) is associated with participation in preferential property tax programs (TAX) and carbon programs (CARBON), measured as fractional shares of ownerships and acres enrolled in either program. Fractional regression models show that higher property tax concern is positively associated with TAX participation but negatively associated with CARBON participation. Participation in TAX is also positively associated with CARBON, consistent with a program engagement effect. These results support a two-margin framework in which preferential tax programs reduce immediate holding costs, while carbon programs require longer-term contractual commitments and active management capacity. The findings suggest that holding-cost pressure increases demand for tax relief but may reduce willingness to enroll in carbon contracts, implying that property tax policy and carbon incentives function as complements rather than substitutes in promoting active forest management.

Keywords: family forest landowners, property taxation, carbon programs, forestland ownership, landowner participation

Summary: Using state-level NWOS data, we test whether property tax concern predicts enrollment in tax and carbon programs. Results show that tax concerns raise tax-program participation but lower carbon participation.

Session: 9. Private Forest Landowners: Behavior, Adoption, and Policy Engagement

Perceived Future Revenue Risks Across Forest Income Streams: Insights from the Southern United States

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Private forest landowners in the Southern United States face growing uncertainty in sustaining revenue from multiple forest-based income streams, including timber products, non-timber forest products (NTFPs), land-based services, forest carbon credits, and conservation payments. This study examines factors associated with landowners' perceived future challenges in generating revenue from these income sources. Using data from a regional landowner survey across the southern United States (n=277), we estimated binary logistic models and average marginal effects to assess how socio-demographic characteristics, ownership motivations, prior revenue experience, and pandemic-related disruptions influence anticipated revenue risks across income streams. Overall, 41% of landowners reported expected challenges in timber revenue, followed by 23% for forest carbon credits. Perceptions of future revenue risk vary by revenue source and landowner characteristics. Landowners motivated primarily by timber production reported higher anticipated challenges across multiple revenue streams. Pandemic-related financial disruptions were also important: delayed timber harvests and income losses were associated with higher perceived timber revenue challenges, while income declines were additionally linked to anticipated challenges in carbon credit markets. Prior revenue experience showed source-specific effects, and selected socio-demographic characteristics (such as education, gender, and occupation) were associated with variation in perceived risks. These insights can inform targeted policies and extension programs aimed at strengthening revenue diversification, improving resilience, and supporting sustainable forest management in the Southern United States.

Keywords: private forest landowners, timber revenue, forest carbon credits; revenue risk perception, pandemic impacts

Summary: This study examines factors shaping landowners' perceived revenue risks, with timber-focused ownership and pandemic impacts increasing timber and carbon concerns and demographics influencing expectations across forest income sources.

Session: 10. Trade Policy and International Forest Product Markets

Economic Impacts of the 2025 Washington State Tax Package on the Forestry Sector

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In early 2025, Washington State enacted a legislative tax package to address structural budget deficits. While high-earner surcharges dominated public debate, the package introduced broad-based changes to local sales taxes on services and the K-12 property tax system. For Washington's forestry and wood product manufacturing sectors, these reforms create new fiscal pressures on land-intensive operations and increase the cost of essential professional services. This study employs a Washington-tailored, multi-regional Computable General Equilibrium (CGE) model to quantify these impacts. Following the GTAP framework, the model segments the global economy into three regions (Washington State, the Rest of the United States (RUSA), and the Rest of the World (ROW)) to capture inter-regional trade linkages and "leakage" effects. We simulate various shocks to mimic specific tax instruments in the proposal. Preliminary expectations suggest that while the forestry sector is a relatively small portion of Washington's total GDP, it will experience disproportionate impacts due to its high reliance on land as a primary factor of production and its sensitivity to professional service costs. The CGE analysis is expected to reveal a "price wedge" effect, where increased operational costs in Washington lead to a decrease in regional competitiveness, potentially driving a shift in timber investment and production toward the Rest of the United States. This research provides critical insights for policymakers regarding the unintended consequences of broad-based tax shifts on trade-exposed, rural-dependent industries.

Keywords: tax, forestry, CGE

Summary: This study evaluates the impact of 2025 Washington tax reforms on the forestry sector using a CGE model. It highlights how the tax can alter regional competitiveness, timber investment and unintended consequences for trade-exposed industries.

Session: 10. Trade Policy and International Forest Product Markets

Impact of Coastal Flooding and Storm Surge on Global Wood Product Demand

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Coastal flooding and storm surges have emerged as critical climate-related risks due to their substantial economic and ecological impacts on coastal regions worldwide. In wood product markets, these events may constrain supply by damaging forest resources while simultaneously stimulating demand through infrastructure repair and construction of new buildings and other structures due to population relocation to less vulnerable areas. This study investigates the impact of coastal flooding and storm surges on global wood product demand, using mean sea level rise as a proxy for the frequency and intensity of coastal flooding and storm surges. We assemble publicly available data on wood product consumption, prices, and key macroeconomic indicators for 157 countries over the period 1994–2020. Estimation of the market demand function indicates that a 1 mm increase in global mean sea level is associated with a 0.19% increase in wood product consumption. The results provide empirical evidence that climate change risks exert a measurable influence on global wood product markets. These findings highlight the growing importance of climate-smart forest management to maintain a stable and resilient wood supply amid escalating climate risks.

Keywords: market demand function, sea level rise, wood product market

Summary: This study examines how coastal flooding and storm surges affect global wood product demand using data from 157 countries. The results show that sea level rise increases wood consumption, highlighting climate risks' growing influence on wood markets.

Session: 10. Trade Policy and International Forest Product Markets

Pulp and Paper Trade and BRICS Alignment: Political Symbolism or Economic Realignment?

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This study investigates whether BRICS alignment is purely a geopolitical development or whether it carries measurable economic implications for trade in pulp and paper products. Using annual data from 2000 to 2024, the results indicate that China's imports have shifted away from the United States as the leading supplier toward Brazil and Russia. Estimates of China's import demand elasticities, derived from the Almost Ideal Demand System, suggest that China's import demand for pulp and paper products is more price elastic with respect to imports from the United States than from Brazil and Russia.

Keywords: BRICS, pulp and paper products, elasticity, import demand, economics

Summary: This study investigates whether BRICS alignment is purely a geopolitical development or whether it carries measurable economic implications for trade in pulp and paper products.

Session: 10. Trade Policy and International Forest Product Markets

Tariff Pass-Through in U.S. Lumber Markets: Evidence from SPF and Composite Price Indices

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Trade policy remains a significant source of uncertainty and market risk in North American forest products markets. Ongoing U.S. import tariffs on Canadian softwood lumber continue to influence prices, investment incentives, and housing affordability, yet the degree to which these duties are passed through to U.S. prices remains contested. This paper examines tariff pass-through in U.S. lumber markets, with particular emphasis on product-level differences between construction-grade SPF lumber and broader market benchmarks.Using monthly data from January 2016 to December 2023, we estimate log-linear regression models linking U.S. lumber prices to softwood lumber duty rates, U.S. consumption, exchange rates, and offshore supply conditions. Prices are represented by the Random Lengths SPF 2x4 delivered Boston series and the Random Lengths Composite Price. The log specification allows regression coefficients to be interpreted as elasticities, providing direct estimates of tariff pass-through.Results indicate that tariff pass-through is substantial and varies meaningfully by product. For SPF lumber, we estimate a pass-through rate of approximately forty six percent, implying that nearly half of imposed duties are reflected in higher U.S. prices relative to a zero tariff counterfactual. In contrast, the Random Lengths Composite Price exhibits a lower pass-through rate of approximately 29 percent. These findings suggest that tariffs have a more pronounced price effect in SPF markets, likely reflecting tighter substitution possibilities and stronger demand linkages for residential construction inputs.The analysis highlights the importance of product-specific market structure when evaluating trade interventions and their implications for market resilience and housing affordability in practice.

Keywords: trade policy, lumber, tariffs

Summary: This study analyzes how U.S. softwood lumber tariffs affect U.S. prices, finding significant pass-through. Econometric results show higher pass-through for SPF lumber than broader indices, with implications for trade policy and housing affordability.

Session: 10. Trade Policy and International Forest Product Markets

Timber Product Market Response to Trade and Harvest Policies

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This study examines the potential impacts of recent U.S. policy changes—including increased tariffs, countervailing duties, and expanded timber harvest targets on National Forests—on U.S. forest product markets. Using the FOrest Resource Outlook Model (FOROM), a market model developed for the Resources Planning Act (RPA) Assessment, we simulate four policy scenarios: (1) increased National Forest harvests, (2) higher duties on Canadian softwood lumber imports, (3) a 10% tariff on all non-NAFTA forest product imports, and (4) a combined policy scenario. Model refinements include disaggregation of timber supply by ownership type, improved representation of U.S.–Canada trade flows, and incorporation of species-specific substitution constraints between spruce-pine-fir and southern yellow pine. Results indicate that duties and tariffs primarily increase softwood lumber prices, with the Pacific Coast region experiencing the largest production gains under combined policies. Harvest increases reduce softwood lumber prices nationally but have limited effects on hardwood markets. Broader tariffs modestly raise prices for some composite wood products, while combined policies amplify price changes across product categories. Findings suggest that trade restrictions and harvest expansions interact to influence regional production patterns and price trajectories, with implications for mill capacity utilization and investment decisions. Limitations include assumptions about tariff persistence and operational feasibility of harvest targets. Future research could integrate workforce constraints, infrastructure readiness, and dynamic trade responses to improve scenario realism. These insights inform policymakers on the economic trade-offs of forest sector interventions amid evolving domestic and international market conditions.

Keywords: forest sector model, tariff, duties, national forests, softwood lumber

Summary: Presenting results of a forthcoming USDA General Technical Report on the impacts of changing U.S. National Forest harvest targets, duties on Canadian softwood lumber, and tariffs.

Session: 11. From Policy to Practice: Conservation Outcomes and Stakeholder Responses

Dynamic Regional Variation in the Inducement and Substitution Effects of Conservation Reserve Program in the US

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Federal and state cost-share programs have long been used to encourage private tree planting in the United States, yet it is not certain whether these subsidies induce additional private investment or merely substitute for planting that would have occurred in their absence. This study examines the dynamic impact of the Conservation Reserve Program (CRP) in private tree-planting using time-series data and a disaggregated regional framework based on the nine USDA Forest Service RPA regions. We used state-space model with time-varying coefficients on government-assisted planting, implemented via the Kalman filter, to capture structural changes in landowner behavior over time. The model controls timber harvest levels, stumpage prices, planting costs, land values, interest rates, and regional socioeconomic characteristics. Allowing the policy coefficient to evolve provides a flexible framework for identifying shifts between inducement and substitution effects and for assessing regional heterogeneity in landowners' plantation behavior. The model shows substantial cross-regional variation in the impacts of CRP. In several RPA regions, cost-share programs exhibit persistent inducement effects, suggesting that public funding stimulates additional private planting beyond subsidized acreage. In contrast, other regions demonstrate substitution patterns, where government-assisted planting crowds out non-assisted private investment. The magnitude and timing of these effects differ markedly across and within regions, indicating that national aggregation can mask important structural differences in landowner responses. These findings highlight the importance of region-specific policy design and dynamic evaluation of cost-share programs to ensure that public investment in tree planting generates additional forest cover and effectively contributes to long-term climate mitigation goals.

Keywords: afforestation, conservation reserve program, cost-share programs, private landowners, state space

Summary: Evaluate whether CRP tree-planting subsidies induce additional private investment or substitute for existing planting across the US using a time-varying state-space framework. Results show substantial regional differences.

Session: 11. From Policy to Practice: Conservation Outcomes and Stakeholder Responses

Evaluating Private Landowner Perceptions and Motivations to Wetland Conservation Program Participation in Oklahoma.

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Sarah Gilmer, Wetlands and Water Quality Specialist, Oklahoma Conservation Commission
Maggie Woods, Wetland Conservation Specialist

Wetlands are among the most productive and diverse ecosystems, delivering a wide range of valuable services to society. Despite their significance, Oklahoma has lost a substantial portion of its wetlands over the last century, resulting in diminished ecosystem benefits. Voluntary conservation initiatives have proven to be effective tools for restoring wetlands and recovering the services they provide. The Oklahoma Conservation Commission (OCC) is currently designing a voluntary wetland conservation program aimed at supporting restoration efforts statewide. To increase participation, it is essential to identify the factors that influence landowners' motivations to participate in conservation programs. This study utilizes a mail-out survey to collect information about landowner participation in wetland conservation programs. This survey targets landowners currently enrolled in conservation programs and those owning lands with high potential for wetland restoration.[OJ1.1] Survey responses will be analyzed using the Analytic Hierarchy Process (AHP) to assess the relative importance of perceived benefits, challenges, and general knowledge of wetlands. We will also examine landowner willingness and barriers to participate in conservation programs. The objective is to identify and minimize barriers to private landowner participation in wetland conservation programs, inform OCC about program design and outreach strategies, and support more efficient program funding. More broadly, the findings may benefit groups, agencies, and organizations involved with wetland conservation.

Keywords: wetlands, landowners, conservation programs

Summary: This presentation examines landowner participation in voluntary wetlands programs in Oklahoma. Survey data and AHP analysis identify motivations and barriers to participation, helping improve program design, outreach and funding efficiency statewide.

Session: 11. From Policy to Practice: Conservation Outcomes and Stakeholder Responses

Public Perception of using Public Lands for Climate Mitigation

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Biological carbon sequestration can support climate mitigation while maintaining sustainable forest management. In the United States, woody plants capture about 13% of annual emissions, and the nation's 640 million acres of public land offer substantial potential for additional carbon storage. Because public lands are taxpayer-funded, public acceptance is critical for carbon-focused policies, yet limited research has examined perceptions of biological sequestration on federally managed lands. This study analyzes public perceptions using a nationwide Qualtrics panel survey measuring public land values, climate beliefs, institutional trust, concerns about carbon initiatives, and familiarity with biological carbon storage. Results indicate limited public familiarity with carbon storage on public lands, with 52% of respondents reporting they were not at all or only somewhat familiar with the concept. Despite this limited familiarity, attitudes toward prioritizing carbon storage were generally neutral to positive: 34% of respondents were neutral, 33% somewhat agreed, and 22% strongly agreed that carbon storage should be a top management priority for governmental land agencies. Ordered logit models examined factors influencing support for carbon management as a federal land agency goal and for designating public lands primarily for carbon storage. Results show that higher climate change awareness and belief, support for immediate mitigation action, greater familiarity and confidence in carbon storage, and stronger perceived importance of public lands are associated with increased policy support. These findings provide empirical insight into public acceptance of biological carbon sequestration on federally managed lands and inform future federal land management and climate policy design.

Keywords: biological carbon sequestration; public lands; climate change mitigation; public perception; forest policy

Summary: This presentation examines public views on using federally managed lands for biological carbon sequestration. A nationwide survey finds limited familiarity but generally neutral to positive support, shaped by climate awareness and personal beliefs.

Session: 11. From Policy to Practice: Conservation Outcomes and Stakeholder Responses

Unlocking Natural Capital: Economics and Innovation for Tropical Secondary and Degraded Forest Restoration along the Pacific Flyway

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Migratory bird populations in Oregon and the Pacific Northwest continue to decline despite extensive active forest management efforts. A substantial proportion of these species winter in tropical forests of Latin America that are experiencing ongoing degradation and deforestation, making tropical forest landscape restoration essential for the long-term viability of these populations. We will present our research that aims to accelerate research in restoration business models and unlock financing for large-scale restoration of degraded and secondary tropical forests along the Pacific Flyway. The initial focus is on Guatemala and Costa Rica connecting them to relevant Oregon migratory bird species. A major knowledge gap persists regarding which management options most effectively alter degradation trajectories while delivering multiple benefits from habitat protection for migratory species to rural economic development. Our approach centers on optimizing restoration trajectories calibrated to varying levels of ecosystem degradation, integrating ecological diversity, livelihood needs, and income generation through viable business models. We employed multi-objective optimization to identify pathways that maximize ecological recovery, reduce financial risk, and support rural development. This initiative also aims to establish a network of over 20 partners across the Americas in support of the Initiative 20x20 and the UN Decade on Ecosystem Restoration to bridge the gap between restoration science and investment. Expected outcomes include a foundational state-of-the-art synthesis and optimal restoration pathways incorporating financial models. This flyway-based framework offers a replicable model for transboundary conservation partnerships linking temperate and tropical ecosystems.

Keywords: optimization, investments, restoration, nature-based solutions

Summary: Oregon migratory birds are declining due to tropical deforestation. This project links restoration in Latin America with financial models and optimization to support habitat recovery, rural development, and scalable restoration across the PacificFlyway.

Session: 12. Ecosystem Services, Conservation Finance, and Stakeholder Engagement

Factors Affecting the Willingness to Pay for Forest Restoration at The Wilds in Ohio

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The Appalachian region is home to the world's largest temperate deciduous forests; however large parts of it have been lost to coal. The coal in this region is preferred due to its low sulfur content. To mitigate the adverse effects of mining, such as landslides, erosion, and surface water contamination, the Surface Mine Control and Reclamation Act (SMCRA) of 1977 was enacted. The law required reclamation of mined land into forests, agricultural areas, residential areas, as well as areas for wildlife habitat. The Wilds is a 9,154-acre reclaimed coal mine in Ohio, serving as a conservation center. The land was given to The Wilds in 1984 by Central Ohio Coal Company. It has acquired accreditation from the Association of Zoos and Aquarium (AZA) and has been open to the public since 1994. It is home to over 25 different threatened and endangered species ranging from Southern White Rhino, Cheetah, and Giraffe to Eastern Hellbender and American Burying Beetle. In this study we will use the contingent valuation method (CVM), to determine the value of forest restoration by asking the visitors about their willingness to pay for forest restoration efforts at the Wilds. The results suggest that while neither information nor area under restoration had any significant effect on WTP, previous knowledge about the benefits of forest restoration did affect the decision to pay positively. The results seem to suggest that people's monetary support toward environmental causes are fixed within a range, and they oscillate from one end of that range to the other depending upon how they are presented with the request.

Keywords: valuation, forest restoration, ecosystem services

Summary: Determine the value of forest restoration by asking the visitors about their willingness to pay for forest restoration efforts at the Wilds in Ohio.

Session: 12. Ecosystem Services, Conservation Finance, and Stakeholder Engagement

Forest Product Firms' Intention to Invest in Payments for Ecosystem Services Programs: A Theory of Planned Behavior Approach

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Concerns about the environmental impacts of business operations have pressurized firms to address environmental sustainability issues and safeguard ecosystem services. Consequently, diverse ecosystem services markets have emerged to facilitate and incentivize business engagement in protecting ecosystem services. In this study, we surveyed forest products firms in the U.S. South and examined their intentions to support nature conservation by financing ecosystem services projects. We draw from the Theory of Planned Behavior and employ structural equation modeling to analyze the forest products firms' attitude and the factors influencing their decisions to invest in ecosystem services projects. The results show that forest products firms hold slightly positive attitudes toward investing in ecosystem services projects but report a low likelihood of actually making such investments. Forest products firms experiencing greater perceived normative pressure from stakeholders, especially regulatory bodies and market actors, and those with more positive attitudes toward ecosystem services are more likely to invest in ecosystem services projects. Watershed protection and soil and erosion control are identified as the most important ecosystem services by forest products firms. The results suggest that strengthening the operational environment facilitating nature conservation within forest product firms and designing projects that prioritize preferred ecosystem services may enhance firms' motivation to finance ecosystem services projects. The findings can help policymakers to design payments for ecosystem services programs and improve the engagement of forest businesses in ecosystem services markets.

Keywords: ecosystem services, forest product industry, partial least square structural equation modeling, payments for ecosystem services, the theory of planned behavior

Summary: Forest Product Firms' Intention to Invest in Payments for Ecosystem Services Programs

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Session: 12. Ecosystem Services, Conservation Finance, and Stakeholder Engagement

Session: 12. Ecosystem Services, Conservation Finance, and Stakeholder Engagement

Valuing Cultural Ecosystem Services in a High-Use Mountain Landscape: A Multi-User Study from the Mt. Everest Region

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Mountain landscapes provide critical socio-cultural ecosystem services (SCES), such as spiritual fulfillment, cultural identity, and recreation. These intangible values are often excluded from economic planning due to non-market characteristics. Using on-site surveys (n = 622), this research captures perspectives from multiple user groups, including Indigenous Sherpa residents, local non-Sherpa residents, guides and porters, mountaineers, and tourists. Respondents evaluated the importance of key SCES using Likert-scale measures, assessed perceived environmental and cultural pressures, and participated in a contingent valuation and choice experiment exercise examining willingness to pay (WTP). Results show consistently high perceived importance of SCES across all groups (mean ≈ 4/5), with mountaineers and Sherpa residents assigning significantly higher values than other users ($p < 0.001$). Perceived pressures, including crowding, waste, and climate impacts were moderate to high and did not differ significantly among groups, indicating shared recognition of management challenges. Nearly all respondents expressed willingness to financially support conservation, with a mean annual WTP approximately US$20 (median US$10), and higher contributions among mountaineers. Qualitative responses further highlighted the cultural significance of festivals, sacred landscapes, and local stewardship institutions, underscoring the limitations of purely monetary valuation approaches. This study demonstrates that SCES can be meaningfully integrated into conservation finance through combined economic and qualitative approaches. While grounded in the Mt. Everest region, the findings offer transferable lessons for forest and mountain landscapes across the world, where cultural values increasingly shape conservation priorities and public support.

Keywords: cultural ecosystem services, non-market valuation, qualitative integration

Summary: This study values cultural ecosystem services using non-market and qualitative methods, revealing user differences, equity concerns, and limits of monetization-offering insights for resilient, culturally grounded conservation in natural landscapes.

Session: 12. Ecosystem Services, Conservation Finance, and Stakeholder Engagement

Wildfire Effects on the Provision of Ecosystem Services in the South Platte River Basin of Colorado

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Conservation easements (CEs) are a key tool for protecting ecosystems and biodiversity, often serving as a flexible alternative to protected areas (PAs). Given the increasing frequency and intensity of wildfires in the western United States, it is essential to understand how these disturbances affect the distribution of ecosystem services (ESs) within PAs versus non-PAs. However, significant knowledge gaps remain regarding the effectiveness of CEs in maintaining ESs post-wildfire relative to other land typologies. Here, we examined the spatiotemporal provision of five key ESs, including carbon storage, water yield, habitat quality, and nitrogen and phosphorus exports, between 2004 and 2024 in the South Platte River Basin, Colorado. Using the Integrated Valuation of Ecosystem Services and Tradeoffs modules, we found that CEs provide the highest levels of ESs, followed by federal PAs and 1km CE buffer areas, outperforming local PAs, private PAs, and developed and non-CE areas. Furthermore, in wildfire-affected regions, CEs demonstrated superior post-fire recovery in carbon storage, habitat quality, nitrogen, and phosphorus exports. These findings suggest that CEs are highly effective in both delivering ESs and maintaining resilience against wildfires.

Keywords: conservation easements, environmental benefits, land use planning, protected areas, wildfire

Summary: We analyzed spatiotemporal ES provision and wildfire impacts across land typologies in Colorado. CEs delivered higher levels of ESs than local and private protected areas, developed, and non-CE areas.

Session: 13. Forest Biomass and Bioenergy Markets

Economics of Forest Residue Renewable Diesel Under Moisture Risk, Yield Uncertainty, and Supply Constraints

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This study quantifies how landowner compensation, moisture exposure, drying energy configuration, and yield differences propagate into the levelized cost of renewable diesel in an Oregon residue setting. Using a dry-mass feedstock cost framework coupled to process scale costing, we show that scale and utilization dominate the cost outcome. Modeled costs range from $4.62 to $5.95 per gallon at the largest scale but increase to $9.21 to $12.83 per gallon under the supply-limited base case. Moisture acts as a compounding constraint, raising costs by $0.59 to $0.92 per gallon at full scale and by $1.89 to $2.47 per gallon at the base case when moisture increases from 37% to 50%. Landowner payments, modeled as a premium in dollars per dry ton, pass through to fuel cost as an almost parallel upward shift, with magnitude governed by yield: a +$80 per dry ton premium increases modeled cost by about +$0.96 per gallon under the higher-yield regime (83 gal per dry ton) and +$1.14 per gallon under the baseline yield regime (70 gal per dry ton). Finally, yield improvements function as a hedge when supply limits constrain utilization: crediting an observed yield uplift for fine milling lowers costs by roughly $0.81 to $1.06 per gallon at the base case while adding only a small penalty at full scale. The results provide a basis for residue contracting and incentive design by bounding the cost of supply reliability and clarifying when moisture control and yield gains materially affect dollars-per-gallon outcomes.

Keywords: forest residues, residue mobilization, landowner compensation, moisture content, supply constraint, economic analysis, renewable diesel

Summary: We estimate $/gal renewable diesel from Oregon forest residues, tracking how landowner premiums, moisture, drying energy, and yield pass through to cost. Scale and utilization dominate. Moisture raises costs; yield gains hedge when supply is tight.

Session: 13. Forest Biomass and Bioenergy Markets

Evaluating Tipping Points from Forest Biomass Use for U.S. Data Center Electricity Generation

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The rapid expansion of cloud computing and artificial intelligence has sharply increased electricity demand from large data centers in the United States and prompted interest in forest biomass as a carbon neutral or carbon negative energy source. This study evaluates whether increased biomass use for data center electricity creates forest carbon tipping points where reductions in forest carbon stocks outweigh the emissions avoided by displacing fossil-based generation. Using a recursive dynamic partial equilibrium model of the U.S. forest sector and forestland base we simulate scenarios that introduce additional biomass demand to meet projected data center energy needs and examine the resulting effects on harvest levels, timber markets, land use change and regional carbon dynamics. Tipping points are defined as thresholds beyond which incremental biomass extraction produces net forest carbon losses greater than the carbon benefits from alternative electricity sources. We compare a regional sourcing strategy in which biomass is procured near data center locations with a flexible offset-style framework that allows energy gains in one region to compensate for emissions in another. Results identify conditions under which biomass-based electricity can generate net carbon benefits as well as scenarios in which intensified harvest pressure reduces forest carbon stocks and diminishes climate mitigation gains. Market feedbacks, regional differences and land use responses play central roles in determining outcomes and underscore the importance of scale and sourcing policy in assessing forest biomass as an energy strategy for the growing data center sector.

Keywords: bioenergy, forest carbon, forest products markets

Summary: We add existing data centers in a partial equilibrium model of the U.S. forest sector and then require scenario-specific levels of their energy demand to be fulfilled from forest-based biomass.

Session: 13. Forest Biomass and Bioenergy Markets

Structural and Economic Assessment of Wood-Based Biomass Power in the United States

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Jagdish Poudel, Adjuct Assistant Professor, Michigan State University: Forest Economist, Michigan Department of Natural Resources

Wood-based biomass power is a dispatchable renewable energy source that supports rural economies and forest management. However, its distinct economic role remains insufficiently understood due to its aggregation with other biomass feedstocks in existing analyses. This study aims to estimate the economic contribution of wood-based biomass power across all 50 U.S. states using Impact Analysis for Planning (IMPLAN) modeling framework and 2024 IMPLAN data. In addition, regression analysis is employed to examine the structural, market, and policy factors influencing variation in wood-based biomass electricity generation across states. Explanatory variables include woody biomass availability, pulpwood consumption and processing capacity, renewable portfolio standards, competition from alternative wood product markets, and rural economic context. By isolating the contribution of wood-based biomass power and identifying its key drivers, this study provides a more nuanced understanding of its role within the forest sector and the broader energy system. The findings are expected to inform energy and forest policy design, support rural economic development strategies, and guide region-specific investment and resource management decisions.

Keywords: wood-based bioenergy, forest-based bioenergy, rural economic development, forest residues utilization, state-level energy generation, bioenergy market drivers, forest sector economies.

Summary: This study estimates the economic contribution of wood-based biomass power across all 50 U.S. states and examines the factors influencing variation in wood-based biomass electricity generation across states. By integrating economic impact modeling with analysis of structural, market, and policy drivers, the study provides insights to inform energy and forest policy design, support rural economic development, and guide region-specific investment and resource management decisions.

Session: 13. Forest Biomass and Bioenergy Markets

Scaling Forest Biomass for Electricity and Its Impacts on Markets, Land Use, and Carbon

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This study examines the implications of scaling up forest biomass demand for electricity generation in the United States, focusing on the interactions between biomass supply, land use, timber markets, and greenhouse gas (GHG) outcomes. As renewable energy strategies increasingly consider biomass for baseload power and potential emissions reductions, understanding the broader market and land-use consequences of increased biomass demand is essential for effective policy and land management. Building on prior work by Xu et al. (2021), which assessed the addition of a single 20 MW biopower facility using the LURA economic model linked to the GREET lifecycle assessment tool, this study expands the analysis by varying facility scale and evaluating the resulting shifts in forest feedstock composition, harvesting decisions, and carbon stocks. The analysis focuses on select states with differing forest resource availability and industry presence, examining scenarios in which electricity demand from biomass more than doubles or quadruples. Results show that feedstock mixes evolve with scale, shifting from sawmilling residues at low demand to pulpwood and logging residues as capacity increases, with spatial sourcing patterns reflecting local forest supply and industry structure. These findings indicate that scaling up biomass demand has complex, non-linear effects on forest management, timber markets, and near-term carbon stocks, emphasizing the need for integrated modeling approaches. The study contributes insights for policymakers and stakeholders evaluating the trade-offs between renewable energy deployment, environmental outcomes, and land-use practices, highlighting the importance of scale, regional context, and supply chain dynamics in shaping the sustainability of forest-based bioenergy.

Keywords: biomass, bioenergy, forest products markets

Summary: We use a forest market model to explore non-linearities in forest bioenergy GHG intensity.

Session: 14. Wildfire Prevention, Mitigation, and Socioeconomic Consequences

Catastrophic Wildfires and Suicide

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Nino Abashidze, Assistant Professor, University of Wyoming
Hannah Hennighausen, Assistant Professor, University of Alaska at Anchorage

We estimate the impact of catastrophic wildfires on suicide. Leveraging an eight-year panel of county-by-month restricted-use mortality data for California, we find that catastrophic wildfires result in a 47% increase in the suicide rate (roughly nine excess suicides) in the six-month aftermath of an event. Exploring sources of heterogeneity, effects are largely driven by males. Mechanisms are explored and suggest that both the loss of property and the direct loss of life play a role, and that these effects may be enhanced by exposure to extreme smoke. These findings suggest that wildfires may be deadlier and more expensive than previously thought

Keywords: natural disasters, mental health, catastrophic wildfire

Summary: Presentation consists of the following parts: background and interest, prior research, data (restricted-use), econometric analysis, robustness checks, implications, and future work.

Session: 14. Wildfire Prevention, Mitigation, and Socioeconomic Consequences

Evaluating the Effectiveness of Wildfire Prevention Programs on Tribal Lands in the United States

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Kenneth Jaramillo, Program Manager RTRL/Prevention, Division of Wildland Fire Management, Bureau of Indian Affairs, Office of Trust Services – DOI

Human-caused ignitions remain a leading source of wildfire risk on Tribal lands in the United States, yet quantitative evidence on the effectiveness of wildfire prevention programs remains limited. This study evaluates the effectiveness of wildfire prevention efforts on Tribal lands by linking the Bureau of Indian Affair's detailed program activity data to observed human-caused fire ignitions from 2012 to 2020. We develop a tribe-year panel dataset that captures a wide range of prevention activities, including education and community outreach, engineering and mitigation actions, law enforcement efforts, and others. These activities are converted from counts into measures of implementation intensity (i.e.: accomplishment hours). The prevention data are combined with ignition records and key weather and fire danger indicators to jointly account for human behavior and environmental conditions influencing wildfire risk. To address potential endogeneity between prevention efforts and wildfire outcomes, we employ the instrumental variable Poisson model, using lagged administrative target hours as exogenous instruments for contemporaneous prevention activities. This approach allows us to isolate the causal effects of prevention efforts on human-caused ignitions. The results provide evidence that wildfire prevention programs are effective in reducing human-caused ignitions on Tribal lands. Findings will be used by wildfire managers to enhance prevention efforts and increase the success of programs.

Keywords: forest policy, human-caused ignitions, instrumental variables, tribal lands, wildfire prevention

Summary: This study assesses wildfire prevention effectiveness on Tribal lands over eight years using activity-level data converted to hours. Results show that prevention and outreach significantly reduce human-caused ignitions.

Session: 14. Wildfire Prevention, Mitigation, and Socioeconomic Consequences

Incentives and Barrier of Private Wildfire Mitigation: Evidence from Western WUI Households

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Wildfire risk to individual parcels is determined by a variety of characteristics at the individual, community, and regional levels. Mitigation at the parcel level, such as improving defensible space, is a crucial component of developing fire-resilient communities amid growing wildfire risks. However, homes are often not sufficiently mitigated against wildfire due to factors such as high costs of mitigation or lack of information on how to reduce their risk. Understanding the reasoning behind household mitigation decisions on private parcels is an important component for policymakers and practitioners seeking to incentivize more proactive mitigation behavior. In this paper, we use data from over 4,000 WUI households across 6 states in the Western United States to investigate the most requested incentives that would encourage WUI households to perform mitigation and the more commonly reported barriers that stand in their way. Additionally, we use a latent-class methodology to identify distinct groups of households that request different types of incentives to encourage them to perform mitigation. This research helps inform mitigation programs and practitioners in understanding which incentive programs could be most effective in their communities.

Keywords: wildfire mitigation, incentives, barriers

Summary: This study uses household survey data of WUI residents to investigate the incentives that would encourage WUI residents to take up more wildfire mitigation and the barriers standing in their way. The findings provide insights for policymakers and practitioners seeking to design more targeted and effective wildfire mitigation programs.

Session: 14. Wildfire Prevention, Mitigation, and Socioeconomic Consequences

Long Term Effects of Large Wildfires on Local Water Quality

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This paper investigates the long-term effects of wildfires on drinking water quality in Colorado. Using data from the National Interagency Fire Center and the Colorado Department of Public Health and Environment, I construct a panel of county-level wildfire exposure and water quality violations from 2000 to 2023. Employing a staggered difference-in-differences framework, I estimate the average and dynamic effects of large wildfires on violations reported by public water systems, disaggregated by contaminant type. Preliminary results suggest that turbidity violations increase significantly in the years following a wildfire, with effects persisting up to five years after the initial event. Nitrate/nitrite violations also exhibit a positive post-fire trend, though the estimates are not statistically significant. These early findings point to the potential for wildfires to impose long-term costs on drinking water systems and raise important questions for public health, water infrastructure planning, and post-fire mitigation policy.

Keywords: water quality, environmental economics, wildfire

Summary: Exploring the connection between wildfire and water quality, economic consequences within, and policy implications.

Session: 14. Wildfire Prevention, Mitigation, and Socioeconomic Consequences

The Effect of Wildfire on Violations of Regulatory Drinking Water Standards in the US

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Wildfires pose a threat to drinking water supplies by altering watershed conditions and straining treatment infrastructure. We compile a national panel dataset linking 2,955 public water systems serving over 84 million people to upstream wildfire activity from 2004–2023 and econometrically estimate the relationship between burn severity, Safe Drinking Water Act (SDWA) violations, and water treatment costs. We find that high-severity wildfire significantly increases both SDWA violations and treatment costs, with effects persisting for up to ten years following disturbance. A one percentage point increase in upstream high-severity burn area is associated with a 5.9% increase in violations and a 6.3% increase in treatment costs. In contrast, low-severity wildfire has no measurable effect. We estimate that historical wildfires contributed approximately $1.9 billion in combined medical expenditures and water treatment costs over the study period. These findings have important policy implications for targeted fuel treatment investments aimed at reducing wildfire risk.

Keywords: wildfire, drinking water, risk

Summary: Showcase a data synthesis effort and provide evidence of the understudied relationship between wildfire and human health outcomes through degraded source water quality.

Session: 15. Forest Management and Silviculture Economics

Comparative Economic Analysis of Even-Aged and Uneven-Aged Forest Management of Douglas fir in Western Oregon

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Mindy Crandall, Associate Professor, Oregon State University
Ajay Sharma, Associate Professor, Arburn University

Even-aged silviculture dominates Douglas-fir (*Pseudotsuga menziesii*) management in Western Oregon, yet increasing interest in continuous-cover forestry and carbon pricing has renewed attention to the potential economic performance of uneven-aged systems. This study examined the conditions under which uneven-aged Douglas-fir management can become economically competitive with the even-aged management systems in Western Oregon under varying financial and carbon market conditions. Both systems were evaluated using a consistent land expectation value (LEV) framework with identical timber prices, carbon values, and discount rates. For even-aged management, higher planting densities with no thinning regime maximized total LEVs, reaching \$9,602.94 ha^{-1} under a 30-year rotation. The most competitive uneven-aged regime, defined by a residual basal area of 23.0 m^2 ha^{-1} and a 10-year cutting cycle, achieved a substantially lower LEV of \$4,226.53 ha^{-1}. Sensitivity analyses indicate that higher discount rates sharply reduce LEVs under both systems, while higher carbon prices increase LEVs and narrow, but do not eliminate, the profitability gap between management systems. Overall, uneven-aged management becomes relatively more competitive under low discount rates and higher carbon prices, but even-aged management remains financially dominant in Western Oregon.

Keywords: Douglas-fir, even-aged systems, uneven-aged systems, thinning, carbon price, land expectation value

Summary: It will be economic comparison between even-aged and uneven-aged forest management of Douglas fir in the western Oregon.

Session: 15. Forest Management and Silviculture Economics

Economic Assessment of Different Silvicultural Prescriptions in the T3 Watershed Experiment at Olympic Experimental State Forest

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State forest management agencies operate under continued tension between fiduciary obligations to trust beneficiaries and expanding ecological and social objectives. The T3 Watershed Experiment at the Olympic Experimental State Forest (OESF) in Washington State provides a rare operational-scale platform to evaluate whether novel silvicultural prescriptions can achieve financial performance comparable to conventional management while broadening the Washington Department of Natural Resources' (DNR) silvicultural toolbox. This paper presents a comprehensive economic assessment of five upland prescriptions; Standard Variable-Retention Harvest (VRH), Ethnoforestry Variable-Density Planting (EVDP), Ethnoforestry Variable-Ratio Polyculture (POL), Complex Early Seral (CES), and Accelerated Variable-Density Thinning (AVDT). Using Forest Projection System (FPS) growth and yield simulations across 106 research units distributed among four experimental blocks, the study evaluates projected financial outcomes over a 2024–2102 planning horizon. The analysis uses discounted cash flow methods to estimate net present value (NPV), gross stumpage revenue, and cumulative silvicultural and management costs per acre. Sensitivity analysis examines how variation in discount rates, timber prices, and establishment assumptions influences the comparative performance of different prescriptions. Cost-structure differences and the temporal distribution of revenues are also assessed to characterize investment profiles and exposure to biological and market uncertainties. A preliminary analysis shows that prescription rankings are not stable across discount rates, with some novel prescriptions performing competitively at lower rates but not as rates increase. By providing the first rotation-length financial comparison grounded in operational-scale T3 data, this paper establishes a replicable framework for evaluating the economic implications of adaptive forest management on state trust lands.

Keywords: silvicultural prescriptions, net present value, discounted cash flow, forest economics

Summary: Can novel silvicultural prescriptions compete financially with conventional harvest on state trust lands? This study uses operational-scale T3 data from Washington's Olympic Experimental State Forest to compare different financial tools.

Session: 15. Forest Management and Silviculture Economics

Regenerating Northern Hardwoods: Challenges, Impacts, and Management Solutions

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Managers are often faced with difficult decisions on what management techniques should be for Northern Hardwood Forests' resilience has been a key focus in management decisions due to regeneration challenges caused by climate change, wildlife pressures, and shifting ecological conditions. Managers often face tough choices about which management strategies to implement and how to foster healthy, resilient forests that support wildlife, timber, and ecosystem services. This study uses growth and yield simulations in FVS and economic analysis to evaluate northern hardwood forest management, focusing on compositional goals, rotation ages, and harvest methods. used and how to create healthy and resilient forests to produce wildlife, timber, and ecosystem services. Three management scenarios were evaluated: no active management (baseline), no management with no regeneration, and uneven-aged group selection reducing basal area from 120 to 80 ft² per acre without regeneration, with removal volumes later paired to market values to assess costs and benefits. Results showed that the baseline had the highest trees per acre, while no management with no regeneration produced the highest basal area and merchantable volume, and thinning resulted in the lowest basal area and merchantable volume.

Keywords: forest vegetation simulator, FVS, silviculture, management methods, forest resiliency

Summary: Current and alternative management practices throughout the northern hardwood forest range are simulated in FVS to determine what management practice is best for northern hardwood forest regeneration.

Session: 15. Forest Management and Silviculture Economics

Influence or Interference? Understanding Crowding Effects in Forest Management Adoption

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More than half of the private forestland in the U.S. is under non-industrial private forest (NIPF) ownership. Understanding NIPF landowners' decision-making is crucial for developing effective policy that promotes sustainable forest management practices and ensures forest health. This study investigates the factors influencing the adoption of different management practices, with a focus on potential crowding effects among these practices. Drawing on data from over four hundred NIPF landowners in the U.S. central hardwood region, a series of binary logistic regression models were employed to analyze the relationship between landowner and forestland characteristics and the likelihood of adopting various management practices, like invasive plant management, forest stand improvement, and grapevine control. The findings reveal that factors, such as forest acreage, proximity of landowner residence to the forest, and education level, significantly affect the likelihood of adopting management practices. More importantly, this study found evidence of crowding-in effects, where implementing one practice increased the probability of adopting others, suggesting a preference among NIPF landowners for a diverse approach to forest management.

Keywords: forest management, non-industrial private forest, crowding effect, landowner decision-making

Summary: This presentation examines factors influencing the adoption of sustainable forest practices using survey data and logistic regressions. Results show that forest size and proximity matter, and adopting one practice affects the adoption of others.

Session: 15. Forest Management and Silviculture Economics

Understanding Private Landowner Strategies for Managing Wild Pigs: A Combined Cluster and Structural Equation Modeling Approach

***Nana Tian**,* Associate professor, University of Arkansas at Monticello (*tian@uamont.edu*)

Wild pigs (Sus scrofa) pose a significant threat, causing substantial ecological and economic damage to natural ecosystems, agriculture, and forestry through destructive behaviors of wallowing and rooting. Addressing this widespread issue urgently requires effective and sustained management strategies, especially involving private landowners, who are a critical stakeholder group in the West Gulf Coastal Plain (WGCP). This study aims to identify landowner typologies in wild pig management and to examine factors influencing their intentions to engage in such efforts in Arkansas, Louisiana, and East Texas. We employed a mixed method of cluster analysis and structural equation modeling (SEM) based on the Theory of Planned Behavior (TPB). Cluster analysis revealed three distinct landowner groups based on their familiarity with and experiences of wild pig damage and management efforts: Unaware Bystanders, Frontline Responders, and Cautious Observers. SEM was employed to assess the belief structures influencing behavioral intentions across the entire sample and within each identified cluster. Results indicated that beliefs and attitudes were the most influential predictors of intended behavior, which varied across the landowner clusters. The findings highlight the heterogeneity in landowner responses and offer practical implications for developing targeted outreach strategies, policy interventions, and collaborative management approaches.

Keywords:

Summary:

Session: 16. Wood Supply Optimization, and Life Cycle Impacts

Environmental and Economic Assessment of a Wood-Based Energy System for Space Heating

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Space heating represents a major share of U.S. energy demand, accounting for approximately 42% of residential and 36% of commercial energy use, respectively. Wood fuel being a renewable source offers an opportunity to reduce fossil fuel dependence while supporting local forest resource utilization and rural economies. This study conducted a comparative environmental and economic performance of locally sourced wood-based institutional space heating systems relative to conventional fuel oil systems in Allegany and Garrett Counties, Maryland. Using regionally representative operating conditions, an ISO 14040–compliant life cycle assessment (LCA) was conducted to compare the environmental impacts associated with generating usable thermal energy from woody biomass and conventional fuel oil. The functional unit was defined as the delivered thermal energy for institutional heating. A cradle-to-grave system boundary ("extraction-to-use in school") was applied, encompassing feedstock production or extraction, fuel processing, transportation, combustion, and on-site heat delivery, with an emphasis on locally sourced biomass supply chains. Life cycle inventory data were drawn from project-specific operational information and supplemented with peer-reviewed literature and secondary sources. Additionally, a comparative economic analysis was conducted to evaluate the cost performance of a wood-based heating system. By integrating the results of environmental and economic assessments, this study provides evidence-based insights into the viability of wood-based energy systems as cost effective, lower-impact heating options for institutional heating applications.

keywords: woody biomass, energy uses, space heating, GHG emission, PM10, cost of energy

Summary: This presentation evaluates and comparing the environmental and economic performance of wood biomass-based space heating systems relative to conventional fuel oil systems in an institutional facility. The findings inform forest managers, facility operators, and policymakers considering expanded use of wood biomass-based energy for space heating**.**

Session: 16. Wood Supply Optimization, and Life Cycle Impacts

Economic and Policy Determinants of Mass Timber Demand in the United States

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Mass timber has been transforming the building and construction industry in the United States since early 2010s. The growing interest in mass timber and the increasing number of projects nationwide necessitates the understanding of the economic and policy factors driving this rising demand. Using panel data from all 50 U.S. states spanning 2004 to 2024, this study uses a fixed-effects model and analyze the relationship between the number of mass timber projects and volume of mass timber used with key economic and policy variables. We hypothesize that economic factors such as real lumber price and construction spending are important determinants of mass timber demand in the United States. In addition, we anticipate state level heterogeneity to reflect higher demand in the states that have carbon policies in place and adopted building codes supporting mass timber construction. The findings of this study are expected to inform investors and policymakers by identifying the market and policy drivers shaping the growth and expansion of the mass timber industry in the United States.

Keywords: elasticities, market, decision-support, big timber

Summary: This study estimates the mass timber demand function in the United States using a state-level panel data (2004-2024) and a fixed-effects model by examining the economic and policy drivers governing the growth of mass timber projects.

Session: 16. Wood Supply Optimization, and Life Cycle Impacts

From Forest to Framework: Supply Chain Perspectives on Using Small-Diameter Timber for Mass Timber

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Small-diameter trees (SDTs), measuring less than 255 mm (10 inches), are commonly harvested in forest restoration projects vital to wildfire fuel reduction and ecosystem health. The logs of SDTs, however, are often left unused due to high transportation and processing costs and low market demand. The substantial expense of thinning forests has generated a need to identify value-added outlets for SDTs that can help offset the costs of forest management. The emergence of innovative mass timber (MT) engineered wood products over the last decade offers a promising avenue for transforming low-value SDT logs into high-performance, code-compliant structural products. This review examines the challenges and opportunities associated with utilizing SDTs generated from forest restoration treatments in the production of MT, with a particular focus on supply chain dynamics. A systematic literature review was conducted to evaluate: (1) costs associated with harvesting SDTs, (2) technical feasibility and structural performance of MT products manufactured from SDTs, and (3) supply chain models relevant to SDT-based MT production. Findings indicate that fuel reduction treatments involving SDT removal are generally more costly than conventional harvesting, primarily due to lower recovery rates, longer processing times, and high transportation expenses. Recovery rates from SDT logs vary widely, ranging from 14.3% to 90%, depending on log diameter, species, grading methods, and intended end use. By synthesizing existing knowledge within modern MT manufacturing contexts, this review provides a foundation for advancing SDT-based structural applications and informs stakeholders about the potential of SDTs as feedstock for value-added MT products.

Keywords: small-diameter trees, thinning, forest restoration, mass timber, supply chain, sustainable forest management

Summary: To provide a more grounded understanding of where the supply bottlenecks, technological gaps, market uncertainties and sustainability risks lie in the transition from traditional wood products to large-scale engineered MT applications

Session: 16. Wood Supply Optimization, and Life Cycle Impacts

Life Cycle Assessment (LCA) of a Hardwood Sawmill Facility in the Appalachian Region of the United States.

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Tara Allohverdi, PhD student, Michigan State University
Chris Saffron, Professor, Michigan State University
Raju Pokharel, Assistant Professor, Michigan State University

Life Cycle Assessment (LCA) is the recognised method for quantifying and interpreting environmental impacts to make consumer, business, policy, and technical decisions that best support environmental initiatives. This study examines, gate-to-gate, the manufacturing process of hardwood products in a sawmill facility. This study spans a time horizon of one year, located in the Appalachian region of The United States. A sub-scenario is considered using documented, potential carbon sequestration from timber growth. This includes permutations that are partially renewable, to gauge the displacement of petroleum with biomass to lower greenhouse gas (GHG) emissions. Energy and mass balances have been performed to track GHG emissions in units of CO2-eq. A detailed impact assessment for timber processing within the sawmill will be provided, gauging the relative contribution of each system component. Results show that impact and inventory, assessments vary greatly depending on raw material species, geographic location, the selected time horizon, and the impact categories selected. Data collection and analysis are based on established LCA principles, utilizing industry-specific data; the Weidema method is used to assess data quality. The comparative analysis scenarios provide insights into the relative environmental performance and potential areas for environmental initiatives that can best be supported by other sawmills with similar processing methods.

Keywords: carbon, LCA, supply-chain

Summary: A life cycle assessment of a hardwood sawmill that uses wood residues to help power a sawmill.

Session: 17. Spatially explicit data, modeling, and decision-support tools

Spatial Concentration of Foreign Landownership in U.S. Agricultural and Forest Land Markets

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Foreign ownership of land in the United States has generated increasing debate in land markets, forest policy, and national governance, yet its long-run spatial structure remains insufficiently understood. Using data disclosed under the Agricultural Foreign Investment Disclosure Act (AFIDA), this study conceptualizes foreign landownership as a stock-based outcome, reflecting cumulative and path-dependent investment decisions in agricultural and forest land markets. Exploiting a country–state–year panel, the analysis adopts a two-stage hurdle framework to distinguish between entry decisions aggregated at the country-of-origin level, reflecting the collective behavior of individual foreign investors, and subsequent landholding intensity. Entry is modeled using a binary logit specification, while conditional landholding scale is estimated via a log-linear regression. Explanatory variables are grounded in the Ownership–Location–Internalization (OLI) framework and capture state-level economic fundamentals, country-of-origin landholding scale and geographic concentration, ownership structures, and spatial competition. To account for spatial interdependence, the model incorporates Herfindahl–Hirschman indices of foreign landownership concentration and spatially lagged measures based on state contiguity. Results reveal a sequential investment process. Market entry is shaped by state market size, accumulated foreign land presence, and ownership structures, while higher in-state concentration deters entry but clustering in neighboring states promotes participation. Conditional on entry, landholding intensity is strongly associated with land composition, particularly forest land, and responds negatively to local and neighboring competitive pressure. Overall, the findings demonstrate that foreign landownership in the United States is spatially concentrated, hierarchical, and regionally interconnected, with important implications for forest land markets and land governance.

Keywords: forest land markets, foreign land investment, spatial concentration

Summary: This presentation examines foreign ownership in US agricultural and forest land markets, using a two-stage hurdle model to show how spatial concentration and regional competition shape entry and limit landholding expansion across US states.

Session: 16. Spatially explicit data, modeling, and decision-support tools

Landscape Interactions of Optimal Wood Supply to Mills for the Continental United States

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Different forest product processing facilities across the United States interact differently with the landscape, with varying sizes and shapes of procurement areas to fill demand. Previous work made use of forest ownership and pricing data to identify regions of high merchantability across forests in the United States, offering valuable insights into broad economic understanding. To develop a greater understanding of costs and markets across the United States, we propose modeling mill demand and its interaction with the landscape. Modeling of the forest commodities available on the landscape was done with 250-acre resolution hexagonal networks (hexnets). Data was used from 2360 mills for location, product type, and demand. Estimated travel time, distance, and cost between mills and hexes were calculated using network analysis in ArcGIS. Optimization to maximize the demand of mills while minimizing cost will model optimal market utilization of the forest commodities across the landscape of the continental United States. Results would indicate priority landscapes to harvest and available wood supply to meet current mills' demand. This information could aid in informing policymakers, managerial staff, and researchers in identifying landscape areas that could benefit from increased wood volume harvesting while being economically efficient.

Keywords: network analysis, optimization, procurement zones, united states

Summary: A new modeling approach evaluates how forest product processing facilities interact with the landscape across the United States. Determining the market optimal usage of forest products to meet mill demand while minimizing cost.

Session: 17. Spatially explicit data, modeling, and decision-support tools

Two Decades of Ignition: A Spatiotemporal Analysis of Texas Wildfires (2005–2024)

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A better understanding of spatiotemporal wildfire distribution is vital for identifying the complex relationship between ignition points and their environmental triggers. While natural and human-caused ignitions have risen significantly, a critical gap remains in the spatiotemporal characterization of these events across the Southern United States, with Texas being particularly under-examined. This research leverages a 20-year record of roughly 243,000 wildfires to analyze shifts in ignition patterns at the county level, providing a high-resolution view of Texas's evolving fire landscape. We use Negative Binomial models to quantitatively assess how key factors are associated with the spatial distribution of wildfires. Our results show that wildfire occurrence has increased significantly, with more fires occurring in the southern part of the state in recent years. Findings indicate that anthropogenic activity is the primary driver of fire occurrence, accounting for more than 90% of all wildfire ignitions in Texas throughout the study period. Road density and crime rates emerge as key social predictors of fire activity, both showing a strong positive correlation with ignition frequency. Furthermore, the expansion of the Wildland-Urban Interface and the presence of grassland fuels emerge as the most influential land-cover drivers, with grasslands exhibiting a more pronounced impact on fire occurrence than forested areas.

Keywords: wildfire, spatiotemporal, Texas

Summary: This research leverages a 20-year record of roughly 243,000 wildfires to analyze shifts in ignition patterns at the county level in Texas.

Session: 17. Spatially explicit data, modeling, and decision-support tools

A Comparative Analysis of Structural Changes in Kentucky Forest Sector

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The relative shares of the primary input factor variables of labor and capital in the value added can describe the structure of an economic sector. Therefore, changes in the sector's structure can be measured as changes in primary input shares in the value added. Kentucky forest sector has grappled with persistent labor shortages, retention, and skill mismatches, which threaten its long-term competitiveness and sustainability. To address these challenges, the sector has employed strategies, including automation, to substitute capital for labor and boost productivity. Accordingly, the sector has witnessed some structural change over the years. This study conducts a comparative analysis of factor input shares across 29 industries that constitute Kentucky forest sector from 2001- 2022 in order to shed light on the sector's input shifts over time. Using annual primary factor input data, we computed labor and capital shares for 29 forest industries (2001-2022). Employing a generalized additive model (GAM), we estimated smooth trends in labor and capital shares. Findings reveal substantial variability in factor input shares and trends over the years. Notably, three paper and paperboard manufacturing industries exhibited higher capital shares (60-74%), strong labor-capital complementarity. 26 industries, including furniture-related products, forestry and forest extraction, building components and millwork, and primary wood manufacturing, remained labor-intensive. These results highlight the need for differentiated modernization strategies, particularly in automation and digitalization upstream, due to capital intensity dominance, while downstream industries prioritize viable incentives for workforce development, recruitment, and retention to attract younger generations to the forest labor force.

Keywords: structural change, forest sector, factor shares, substitution

Summary: This study provides a comprehensive framework for understanding industrial input divergence in Kentucky forest sector and provides policy insights on the need for differentiated modernization strategies in both upstream and downstream industries.

Session: 18. Integrating Economics, Ecology, and Climate in Forest Management

Cost and Benefit Analysis of Conservative Forest Management

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Yanshu Li, Associate Professor, University of Georgia

This study explores the feasibility of integrating biodiversity conservation objectives into decision-making frameworks traditionally dominated by timber economics. A linear programming approach is applied, with timber value serving as the objective function and biodiversity is introduced as a minimum threshold constraint. This biodiversity value is measured through ecological metrics such as species richness, forest size, or other ecological attributes, each weighted according to its relative importance. The weighting scheme reflects alternative ecological priorities and thus defines different versions of the constraint. Shadow pricing further reveals the marginal economic cost of stricter biodiversity requirements within the optimization process. By systematically varying these weights, the analysis generates response curves that illustrate trade-offs among biodiversity metrics under different conservation priorities.

Keywords: biodiversity conservation, forest management optimization, economic trade-offs

Summary: This presentation shows how biodiversity constraints can be incorporated into forest management optimization, highlighting trade-offs between timber value and conservation goals and estimating the economic cost of stricter biodiversity requirements.

Session: 18. Integrating Economics, Ecology, and Climate in Forest Management

Natural Resource Contribution Analysis Using Tapestry Multi-Regional Social Accounting Matrices

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Natural resource economists are frequently asked to estimate the "economic contribution" of the forestry, agriculture, mining, and energy sectors. Yet contribution analysis is often conflated with impact analysis or implemented using methods that obscure structural and geographic linkages. Conventional single-region Leontief models compress multi-tier supply chains into aggregated multipliers, limiting transparency and policy interpretation.This paper introduces the Tapestry Multi-Regional Social Accounting Matrix (T-MSAM) framework as a transparent and structurally explicit platform for contribution analysis. Adapted from BEA Benchmark Input-Output and NIPA accounts and disaggregated to state and county levels, the T-MSAM expands sectoral detail to 488 industries, including 82 high-resolution agricultural and natural resource sectors. The framework embeds interregional commodity trade and institutional transfers within a unified accounting system.

Rather than relying solely on aggregated multipliers, T-MSAM reconceptualizes transactions as a graph structure that explicitly traces multi-industry resource–product supply chains across regions. A reverse-expansion logic decomposes Leontief multipliers to recover resource-specific path derivatives, enabling replicable structural attribution of output, value added, income, employment, and tax flows.

By integrating multi-regional accounting with supply chain decomposition, T-MSAM strengthens methodological clarity and provides open access to spatially explicit, reproducible, policy-relevant measures of natural resource sector contributions within and across regions and the nation.

Keywords: multi-regional social accounting matrix, contribution analysis, natural resource economics, structural path analysis, interregional supply chains, open access

Summary: Introduces a multi-regional social accounting framework that decomposes supply chains to provide spatially explicit, reproducible measures of how forestry and natural resource sectors contribute across regional and national economies.

Session: 18. Integrating Economics, Ecology, and Climate in Forest Management

Predicting the Impact of Climate Change on Landscape Composition, Deer, and Outdoor Recreation using a Bayesian Structural Equation Modeling (BSEM) Approach in Minnesota

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Climate change will cause shifts in ecosystems and habitats by the end of the century, impacting landscapes, biodiversity, and ecosystem services. We study the impact of these shifts on landscape, specifically the prairie-forest boundary in Minnesota, deer populations, and outdoor recreation, by studying a broad area bordering Minnesota's Northwoods, containing the prairie-forest transition zone. We use a Bayesian structural equation modeling (BSEM) approach applied to data for 32 Minnesota counties comprising the prairie-forest region, to generate predictions for landscape composition, deer, and outdoor recreation, under climate change. We use three climate projections for three future time periods, 2040-2059, 2060-2079, and 2080-2099. Our results show different shifts between and within landscapes. We find that the current boreal forest dominated by aspen-birch and spruce-fir will undergo substantial shifts by 2100 to a mainly deciduous forest dominated by oak-hickory. We also find a shift in the prairie-forest boundary with an overall decline in forest and an overall increase in prairie. Within the two prairie vegetations considered, we find large declines in native prairie and large increases in prairie-hay-pasture. With climate change and the change in landscape composition, deer populations will have a small decline. Most recreation categories are predicted to increase under climate change, driven largely by warmer temperatures. Skiing is the only recreation category predicted to have a large decline. Our results inform more effective decision-making for climate-resilient natural resource conservation and management.

Keywords: climate change, landscape composition, outdoor recreation, deer, Bayesian structural equation modeling (BSEM).

Summary: We predict substantial shifts in landscape composition, deer, and outdoor recreation, under climate change using a Bayesian SEM approach applied to the prairie-forest region of Minnesota for future time periods: 2040-2059, 2060-2079, and 2080-2099.

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