

Biophysical vs. social availability of woody biomass:

How much is really available on family forestlands in the Northern U.S.?



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Outline

- Background
- Research questions
- Data
- Estimation model
- Results
- Sensitivity analysis
- Final notes

Background

- Woody biomass
 - Renewable energy source
 - New opportunity for landowners
- How much is out there?
 - Focus: 20 northern states
 - FIA estimates:
 - Total: 7,427 million dry tons
 - Family forestlands: 3,992 million dry tons

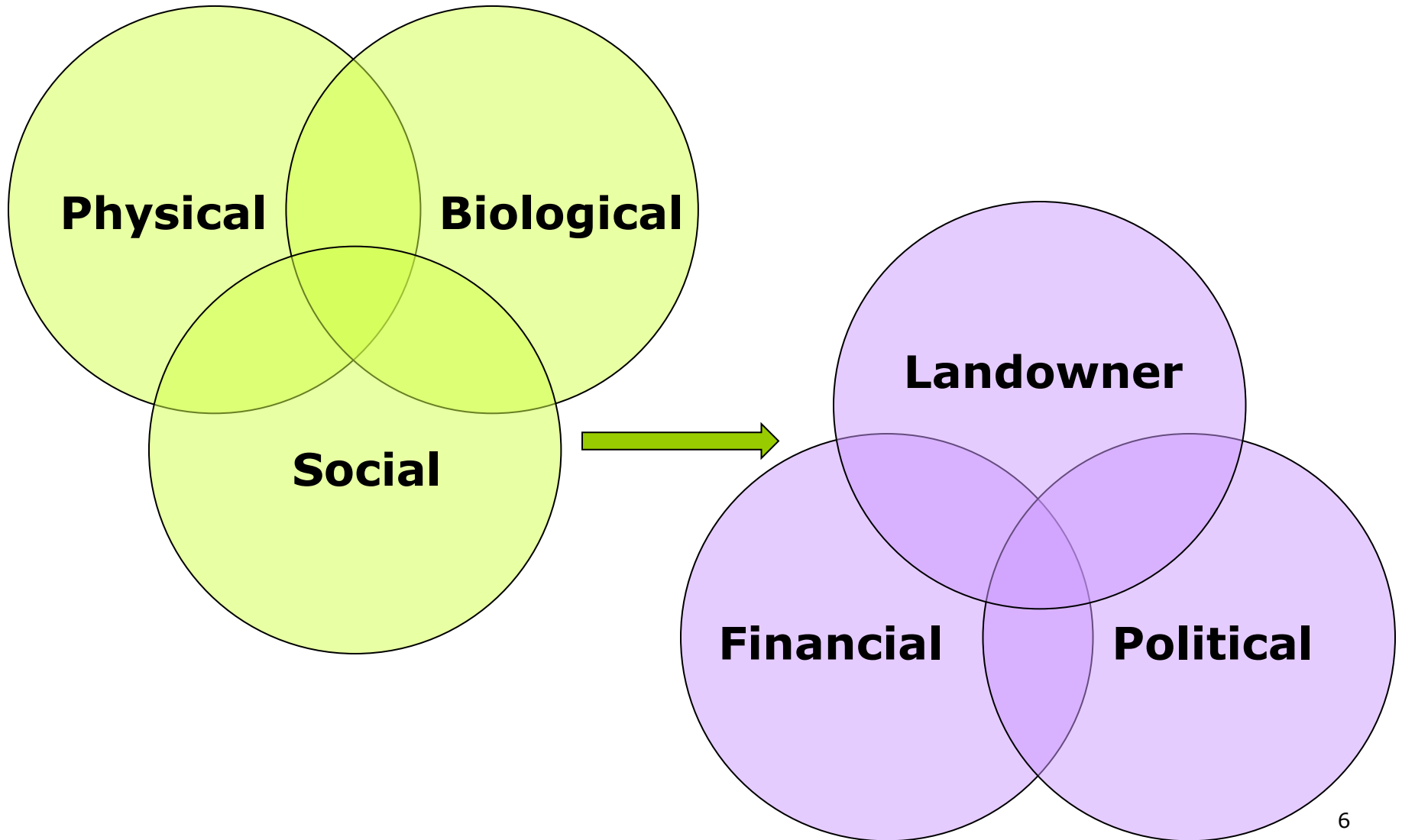
Research Questions

- How much is available?
 - How to define availability?
 - What are the constraints affecting availability?
 - How much is available?
 - What are the implications?

Data

- ❑ USDA, Forest Service, Forest Inventory and Analysis (FIA) Program
- ❑ National Woodland Owner Survey (NWOS)
- ❑ U.S. Geological Survey
- ❑ U.S. Census
- ❑ Census of Canada

General Components of Availability



Particular Constraints I

□ Physical

- Slope (%)
- Physiographic class (xeric, mesic, hydric)
- Site productivity (ft³/ac/yr)

□ Biological

- Stand size (small, medium, large)

Particular Constraints II

□ Social

■ Financial

- Holding size (ac)
- Accessibility (distance to road in miles)
- Development pressure (population gravity index)

■ Political

- Riparian areas (distance to waterbody in feet)
- Zoning regulations (population density in people/mi²)

■ Landowner

- Harvesting likelihood index (low, medium, high) 8

Estimation Model

$$BIOMASS_A = \sum_{i=1}^n \left(\left(\prod_{j=1}^{10} (1 - REDUCTRATE_{ij}) \right) BIOMASS_i \right)$$

Where:

- $BIOMASS_A$: total amount of available biomass
- $BIOMASS_i$: amount of biomass represented by plot i
- $REDUCTRATE_{ij}$: [0,1]
 - If a constraint is absent, $REDUCTRATE_{ij} = 0$
 - If a constraint is present, $REDUCTRATE_{ij} = 0.75$

Thresholds

Constraint	Threshold	Reduction
Biophysical		
Slope	$\geq 50\%$	75%
Physiographic class	hydric	75%
Site productivity	$< 20 \text{ ft}^3/\text{ac}/\text{yr}$	75%
Stand size	small	75%
Social		
Financial		
Holding size	$< 20 \text{ ac}$	75%
Road distance	$\geq 1 \text{ mi}$	75%
Population gravity index	≥ 2000	75%
Political		
Riparian buffers	$< 100 \text{ ft}$	75%
Population density	$\geq 100 \text{ people}/\text{mi}^2$	75%
Landowner		
Harvesting likelihood index	0, 1	75%

Biophysical vs. Social Availability

Constraint	Threshold	Reduction	Woody biomass availability <i>Percent</i>
Biophysical			
Slope	≥ 50%	75%	96.8
Physiographic class	hydric	75%	97.7
Site productivity	< 20 ft ³ /ac/yr	75%	99.7
Stand size	small	75%	97.8
Subtotal			92.4
Social			
Holding size	< 20 ac	75%	86.3
Road distance	≥ 1 mi	75%	99.8
Population gravity index	≥ 2000	75%	95.4
Riparian buffers	< 100 ft	75%	96.2
Population density	≥ 100 people/mi ²	75%	97.4
Harvesting likelihood index	0, 1	75%	47.2
Subtotal			40.4
Total			38.1

Sensitivity Analysis

- Various constraint thresholds
 - 50% increase in threshold value
 - 50% decrease in threshold value
- Various availability reduction rates
 - 50% reduction
 - 100% reduction

Various Constraint Thresholds

Constraint	Threshold value			Woody biomass availability		
	Lower	Base	Higher	Lower	Base	Higher
	<i>Availability reduced if...</i>			<i>Percent</i>		
Biophysical						
Slope (%)	≥ 25	≥ 50	≥ 75	82.2	96.8	99.7
Physiographic class	-	Hydric	-	-	97.7	-
Site productivity (ft ³ /ac/yr)	< 50	< 20	-	73.9	99.7	-
Stand size	-	Small	-	-	97.8	-
Subtotal				58.4	92.4	95.3
Social						
Size of forest holdings (acres)	< 30	< 20	< 10	80.8	86.3	93.0
Road distance (miles)	≥ 0.5	≥ 1	≥ 1.5	96.8	99.8	100.0
Population gravity index	≥ 1000	≥ 2000	≥ 3000	89.7	95.4	97.4
Riparian buffers (feet)	< 150	< 100	< 50	94.4	96.2	98.1
Population density (people/mi ²)	≥ 50	≥ 100	≥ 150	93.2	97.4	98.4
Harvesting likelihood index	0, 1, 2	0, 1	0	33.0	47.2	69.6
Subtotal				23.2	40.4	62.5
Total				14.3	38.1	59.6

Various Availability Reduction Rates

Constraint	Threshold	Availability reduction rate		
		100%	75%	50%
<i>Biomass availability (percent)</i>				
Biophysical				
Slope	≥ 50%	95.7	96.8	97.9
Physiographic class	hydric	97.0	97.7	98.5
Site productivity	< 20 ft ³ /ac/yr	99.6	99.7	99.8
Stand size	small	97.1	97.8	98.6
Subtotal		89.9	92.4	94.9
Social				
Size of forest holdings	< 20 ac	81.8	86.3	90.9
Road distance	≥ 1 mi	99.7	99.8	99.9
Population gravity index	≥ 2000	93.9	95.4	97.0
Riparian buffers	< 100 ft	94.9	96.2	97.5
Population density	≥ 100 people/mi ²	96.5	97.4	98.3
Harvesting likelihood index	0, 1	29.5	47.2	64.8
Subtotal		26.1	40.4	57.1
Total		24.3	38.1	54.8

State Availability Comparison

State	Woody biomass availability (%)		
	Biophysical	Social	Total
Connecticut	92.3	21.3	20.0
Delaware	98.5	6.3	6.3
Illinois	95.7	33.0	31.5
Indiana	95.0	33.4	32.3
Iowa	91.6	38.6	35.0
Maine	93.6	52.8	50.2
Maryland	95.9	19.5	19.4
Massachusetts	94.2	32.3	31.8
Michigan	88.5	39.0	34.7
Minnesota	89.3	36.4	32.3
Missouri	95.9	37.2	36.0
New Hampshire	95.9	44.4	43.3
New Jersey	94.8	14.5	14.5
New York	93.5	43.1	41.3
Ohio	94.5	36.4	35.2
Pennsylvania	94.8	39.8	38.1
Rhode Island	90.8	21.6	21.4
Vermont	94.8	59.1	57.1
West Virginia	83.1	36.0	34.0
Wisconsin	89.0	48.1	43.2
Total	92.4	40.4	38.1

Final Notes

- ❑ Woody biomass availability on family forestlands in northern U.S. is primarily affected by social factors.
- ❑ Efforts are needed to identify additional social factors and improve measurements.
- ❑ This approach is also applicable to other forest resources in other regions.
- ❑ It is important to understand the social dimension of natural resource availability before adopting policies and programs.

Thank you for your attention!



Questions?

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