



# Forest Biomass Supply in the Chesapeake Bay Watershed


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# Outline

- Introduction: Components of Forest Biomass Supply
- Estimating Forest Biomass Supply in the Chesapeake Bay Watershed
- Advantages of the Methodology
- Opportunities for Future Research



# Components of Forest Biomass Supply

- Physical supply
  - Stocks vs. flows (i.e., inventory vs. growth)
- Logistics
  - Harvest and transportation costs
- Availability
  - Ownership
  - Environmental constraints
- Markets
  - Substitutes and competing uses of the raw material



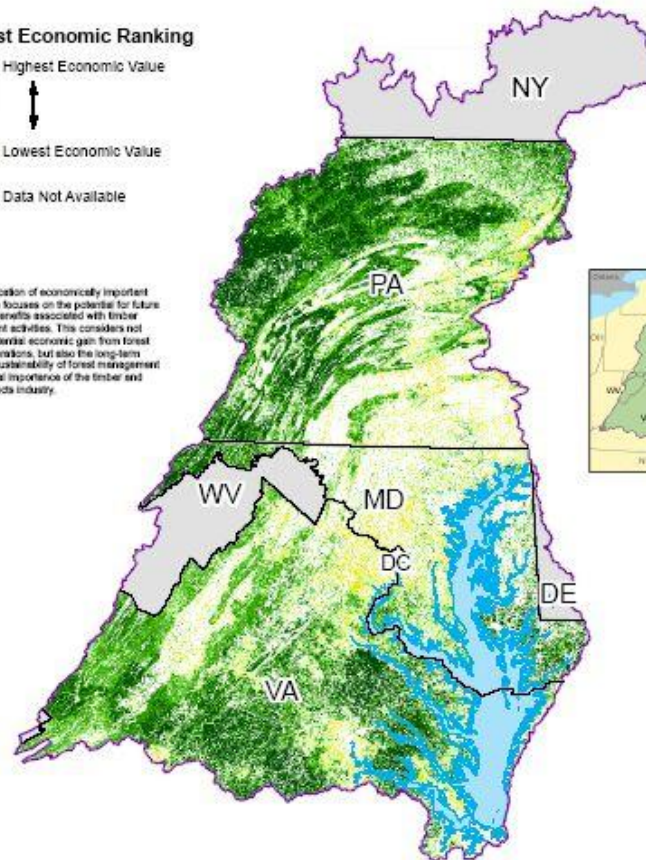
# Estimating Forest Biomass Supply in the Chesapeake Bay Watershed



## Forest Economic Ranking



The identification of economically important forest lands focuses on the potential for future economic benefits associated with timber management activities. This considers not only the potential economic gain from forest harvest operations, but also the long-term economic sustainability of forest management and the local importance of the timber and wood products industry.



Data Source: Chesapeake Bay Program  
For more information, visit [www.chesapeakebay.net](http://www.chesapeakebay.net)  
Disclaimer: [www.chesapeakebay.net/terms\\_of\\_use.htm](http://www.chesapeakebay.net/terms_of_use.htm)



Source: <http://www.chesapeakebay.net/maps.htm>



# Physical Supply

- Based on USDA Forest Inventory and Analysis (FIA) Data
  - Used GIS to identify subset of plots in each state in that are in the watershed
- Estimate biomass potentially available for biofuels (stock)
  - Oven dry tons (ODT)
- Estimate growth rates (flow)
  - Since growth is available in cubic feet, estimate growth as a percent for each state
  - Apply percent rate to biomass inventory to get biomass growth



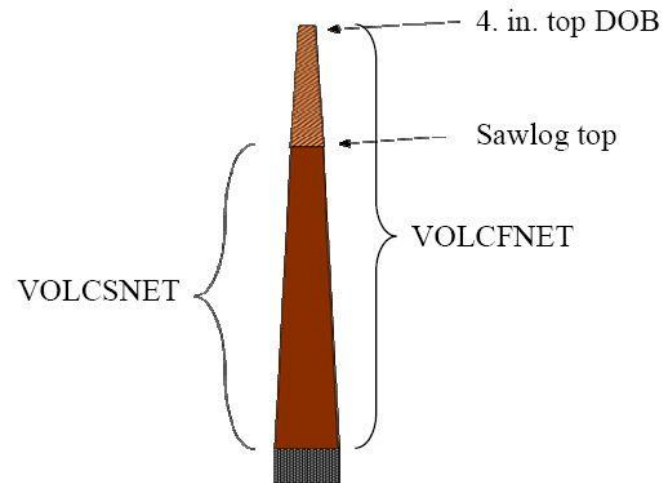


# Potentially Available Biomass

- Estimating “commercial” biomass and “non-commercial” biomass
  - “Non-commercial” biomass =
    - All live biomass (includes branches & stump)
      - merchantable (commercial) biomass (ODT)
      - stump biomass (too costly to harvest)
  - “Commercial biomass” =
    - Pulpwood biomass (ODT)
    - + Sawtimber biomass (ODT)
      - Commercial biomass is not broken out into pulpwood and sawtimber, but we assumed that sawtimber biomass would not be available for biofuels (it’s too valuable in other uses)
      - So, we removed the sawtimber portion...

# Estimating Pulpwood Biomass

- Pulpwood Biomass (ODT) =  
[Pulpwood Vol (cuft)/(Sawtimber Vol (cuft))  
× Total Commercial Biomass (ODT)]



- Sawtimber vol = VOLCSNET (cuft)
- Pulpwood vol = VOLCFNET (Total commercial vol (cuft))  
– VOLCSNET (cuft)



# Estimating Biomass Growth

- Calculate volume growth for each state and use that growth rate to calculate biomass growth
  - Biomass Growth = Biomass Inventory
    - × Volume Growth Rate
    - Unfortunately, Maryland's growth rate is negative
    - "Net" growth = "gross" growth – mortality
    - Mortality must be high in Maryland
      - Probably gypsy moth...
- Still based on FIA data
  - For plots in the watershed boundary






# Physically Available Forest Biomass Inventory and Growth

States	Plpwd Biomass (MODT)	Non-comm Biomass (ODT)	Total biomass (MODT)	Growth Rate (Percent)	Plpwd Biomass Growth (MODT)	Non-Comm Biomass Growth (MODT)	Total Biomass Growth (MODT)
PA	149.6	118.1	267.7	2.3%	3.5	2.7	6.2
DE	3.0	2.7	5.6	3.7%	0.1	0.1	0.2
NY	44.4	32.7	77.1	2.4%	1.0	0.8	1.8
WV	28.8	20.4	49.2	1.6%	0.4	0.3	0.8
VA	141.9	110.3	252.2	3.0%	4.3	3.3	7.6
MD	35.8	32.6	68.4	-1.6%	(0.6)	(0.5)	(1.1)
<b>Total</b>	<b>403.5</b>	<b>316.8</b>	<b>720.3</b>		<b>8.8</b>	<b>6.7</b>	<b>15.5</b>

- Note: inventory is about 45 times as large as growth.



# Estimating “Available & Willing” Biomass Growth

- From pulpwood biomass, subtract current pulpwood use
  - Based on a combination of Timber Products Output (TPO) data and FIA removals
- From non-commercial biomass, subtract a percentage representing slash retention
  - left in the woods for nutrient cycling
- Result is “potentially available” forest biomass
- Multiply this by a “willingness to manage factor”





# Estimating Current Pulpwood Use

- Timber Products Output (TPO) database gives pulpwood use estimate by county for each state
- FIA database gives removals estimate (Sawt. & Pulpw.), which was adjusted using TPO data to estimate pulpwood removals
- Calculate total pulpwood use (including composite products and fuelwood) for the counties that are (mostly or completely) in the watershed
  - Used an average of FIA removals and TPO use
- Calculate ratio of pulpwood use for those counties relative to pulpwood inventory
  - Gives an estimated use rate as a percentage of the inventory in the region
  - Had to make some adjustments for Maryland



## Estimating Current Pulpwood Use as a Percentage of Inventory

States	FIA Pulpwood Inventory (MCuFt)	TPO Pulpwood Use (MCuFt)	FIA Removals/ TPO Use	TPO Pulpwood Use/ FIA Pulpwood Inv	Percent of MD's Demand Supplied	Adjusted (TPO-FIA) Pulpwood Use (MCuFt)	Adjusted PWood Use/ FIA Pulpwood Inv
PA	7,146	65.9	98.0%	0.9%	25%	71.4	1.0%
DE	169	3.6	138.9%	2.1%	5%	5.8	3.4%
NY	2,127	21.8	NA	1.0%	0%	21.6	1.0%
WV	1,286	1.2	240.8%	0.1%	10%	6.2	0.5%
VA	5,972	139.0	135.8%	2.3%	40%	175.7	2.9%
MD	142	25.1	5.7%	17.6%	20%	2.7	1.9%





## Potentially Available Pulpwood Biomass Growth

States	Pwd Biomass (MODT)	Growth Rate (Percent)	Adjusted PWood Use/ FIA Pulpwood Inv	Commercial Use	Growth-Commercial Use	Potentially Available Pwd Biomass Growth (MODT)
PA	149.6	2.3%	1.0%	1.0%	1.3%	1.97
DE	3.0	3.7%	3.4%	3.7%	0.2%	0.01
NY	44.4	2.4%	1.0%	2.4%	1.3%	0.60
WV	28.8	1.6%	0.5%	1.6%	1.1%	0.31
VA	141.9	3.0%	2.9%	3.0%	0.1%	0.10
MD	35.8	-1.6%	1.9%	-1.6%	-3.4%	-
<b>Total</b>	<b>403.5</b>					<b>2.98</b>

• Note: Most (2/3) of the potential is in PA, followed by NY.



# Slash Retention and Willingness to Manage Factors

- Assumed that 30% of non-commercial biomass was left in the woods for slash retention
- For Pennsylvania, New York and West Virginia:
  - “high willingness” = 45%
  - “low willingness” = 15%
- For Virginia and Delaware:
  - “high willingness” = 60%
  - “low willingness” = 25%
- “Willingness factors” can represent social willingness and/or economic availability





# Total Potentially Available Biomass Growth

States	Non-Comm Biomass (MODT)	Growth Rate (Percent)	Slash Retention (Percent)	Potentially Available Non-Comm Biomass Growth (MODT)	Potentially Available Pwd Biomass Growth (MODT)	Total Potentially Available Biomass Growth (MODT)
PA	118.1	2.3%	30%	1.91	1.97	3.88
DE	2.7	3.7%	30%	0.07	0.01	0.07
NY	32.7	2.4%	30%	0.54	0.60	1.14
WV	20.4	1.6%	30%	0.22	0.31	0.53
VA	110.3	3.0%	30%	2.33	0.10	2.42
MD	32.6	-1.6%	30%	-	-	-
<b>Total</b>	<b>316.8</b>			<b>5.07</b>	<b>2.98</b>	<b>8.05</b>



## Annually Available “Willing” Forest Biomass Growth

<b>States</b>	<b>Total Annually Available Forest Biomass (MODT)</b>	<b>Low Willingness to Manage for Biomass</b>	<b>Total Annually Available "Willing" Biomass (MODT) - Low Estimate</b>	<b>High Willingness to Manage for Biomass</b>	<b>Total Annually Available "Willing" Biomass (MODT) - High Estimate</b>
PA	3.88	15%	0.58	45%	1.75
DE	0.07	25%	0.02	60%	0.04
NY	1.14	15%	0.17	45%	0.51
WV	0.53	15%	0.08	45%	0.24
VA	2.42	25%	0.61	60%	1.45
MD	-	15%	-	45%	-
<b>Total</b>	<b>8.05</b>		<b>1.46</b>		<b>4.00</b>





# Advantages of the Methodology

- Done entirely with publicly available data
  - And a dash of “professional judgement”
- Can be replicated relatively easily for a state or for any group of counties



# Opportunities for Future Research

- There's a lot subsumed in the “willingness factors”
  - Social availability
  - Logistics (harvest & transport)
- Competition with other uses of biomass
  - Need better TPO-type data
- More detailed growth modeling
  - Modeling alternative silvicultural practices