Approach for sustainability assessment of southeast pellet production

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U.S. DEPARTMENT OF ENERGY

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U.S. Wood Pellet Trade flow

Example: exports at risk, US pellet exports Valued $650M in 2013, > $1B (est.) by 2016

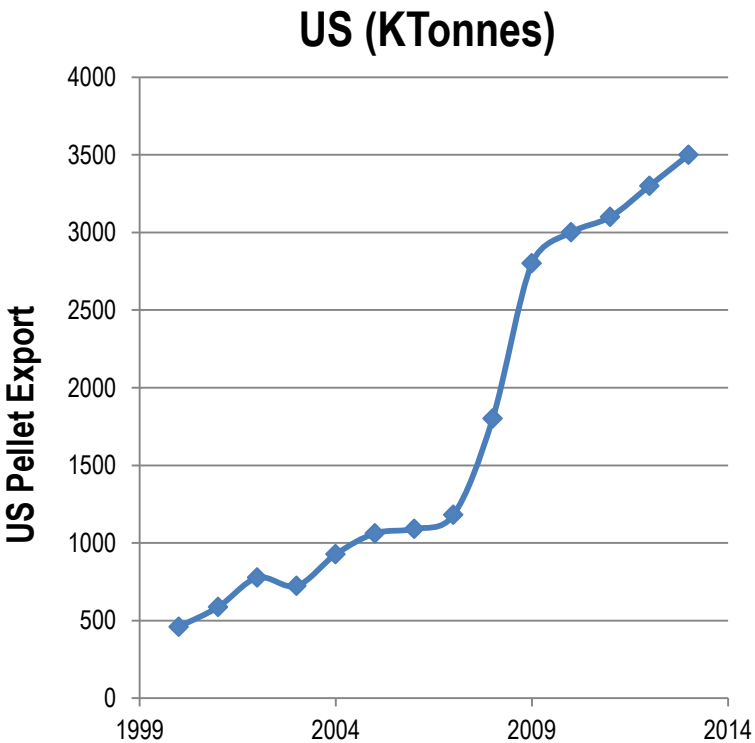
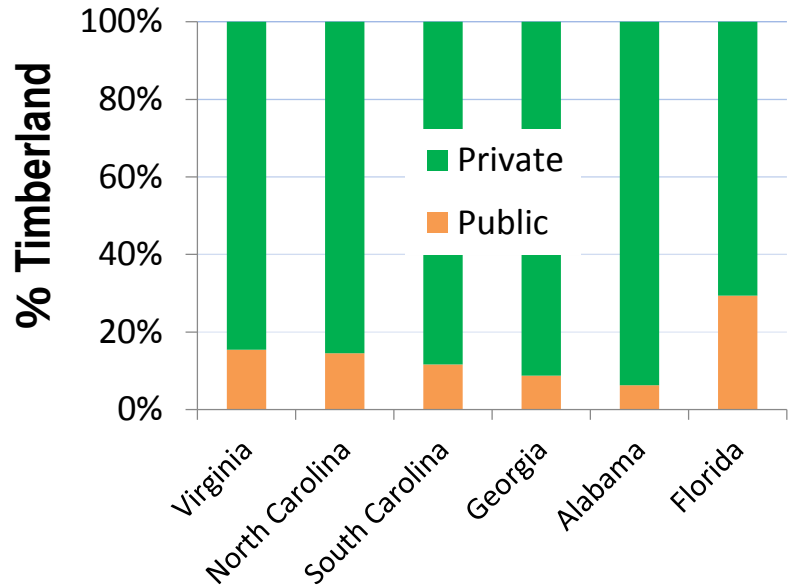


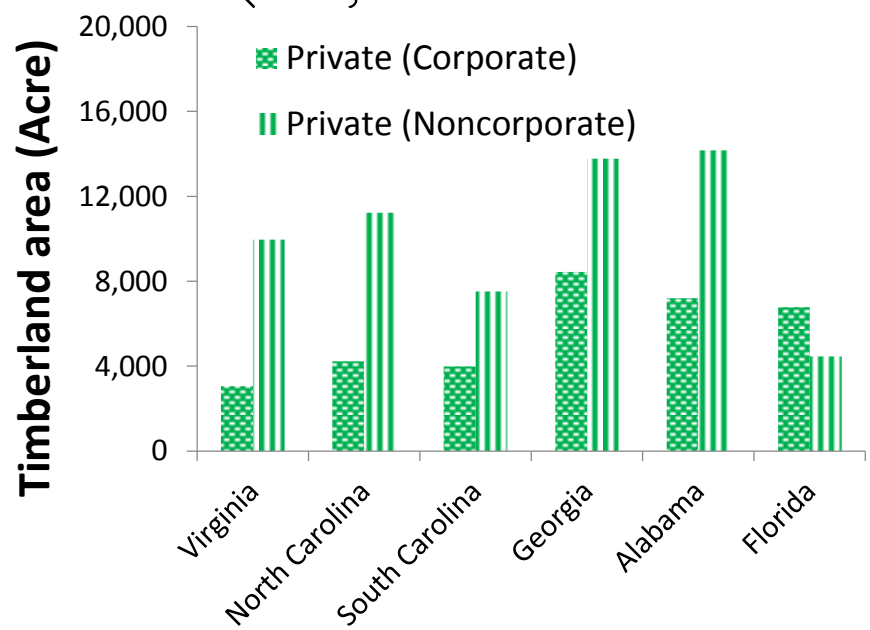
Figure: U.S. Pellet Export (US EIA, 2014)

2010 Wood Pellet Trade flow from US to major EU markets and from Net exporters within EU , in 1000 MT

Data source: Lamers et al., 2013 and Eurostat, 2012

Most US timberland is in SE under private ownership that is mostly noncorporate





Source: FIA RPA 2012; Timberland: forestland capable of >20cft/acre-year of industrial wood

By–products of tree harvest for saw timber and pulp in southeast US are used for bioenergy

Trees are cut and sorted by size.

- Harvest meets standards
  - Corporate forest lands - for example,
    - ✓ Forest Sustainability Initiative (FSI)
    - ✓ Forest Stewardship Council (FSC)
  - Non-corporate lands
    - ✓ Use master loggers
- Follow best practices
  - Branches returned to forest
  - Protection of places providing ecosystem services

Without the opportunity to make pellets for bioenergy, a lot of wood is left in the forest after a clear cut harvest.

Decisions from individual and cumulative perspectives & for all components of the pellet supply chain

Feedstock production → Feedstock logistics → Conversion to pellets → Pellet logistics → Pellet end use

Individual perspective:

Forestry decisions:
- What to plant?
- Where to plant it?
- How to manage it?

Feedstock logistic decisions:
- How to harvest and collect feedstock?
- How to process?
- How to store?
- How to transport?

Conversion decisions:
- What process to use in pellet production?
- What products to produce?
- What coproducts?

Pellet logistics decisions:
- Where and how to transport?
- Where and how to store?

End user decisions:
- What type of wood burner to buy?
- How much pellets are used to displace other energy ?

Cumulative perspective:

Land cover and use patterns and practices

Collection, processing, storage and movement of goods across the landscape

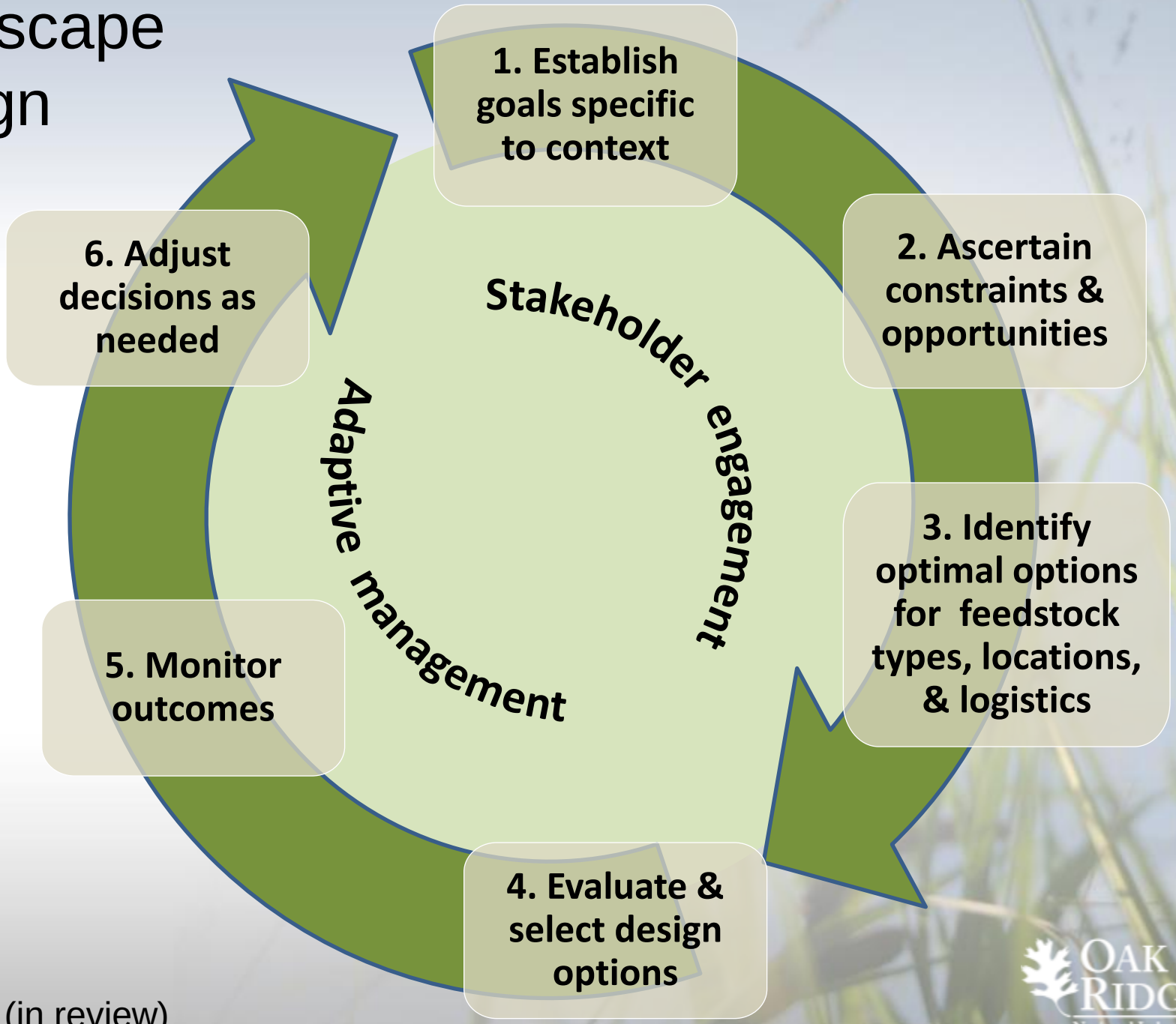
Distribution of pellet mills across the landscape

Transportation and storage of pellets for a region, nation, or export

National and regional choices of wood use

Figure was modified for pellets from Dale VH, KL Kline, D Perla, A Lucier. 2013. Communicating about bioenergy sustainability. Environmental Management 51(2): 279-290.

Landscape Design



Dale et al. (in review)

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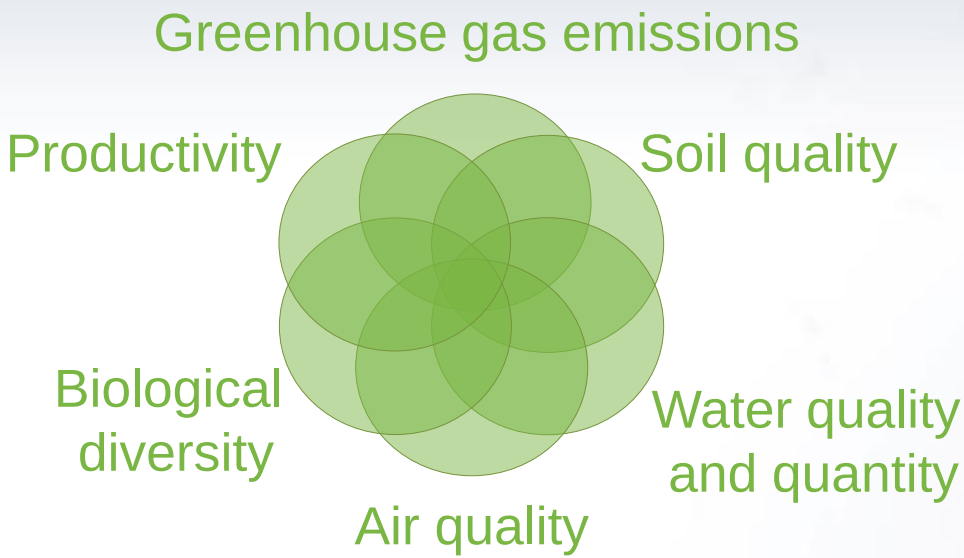
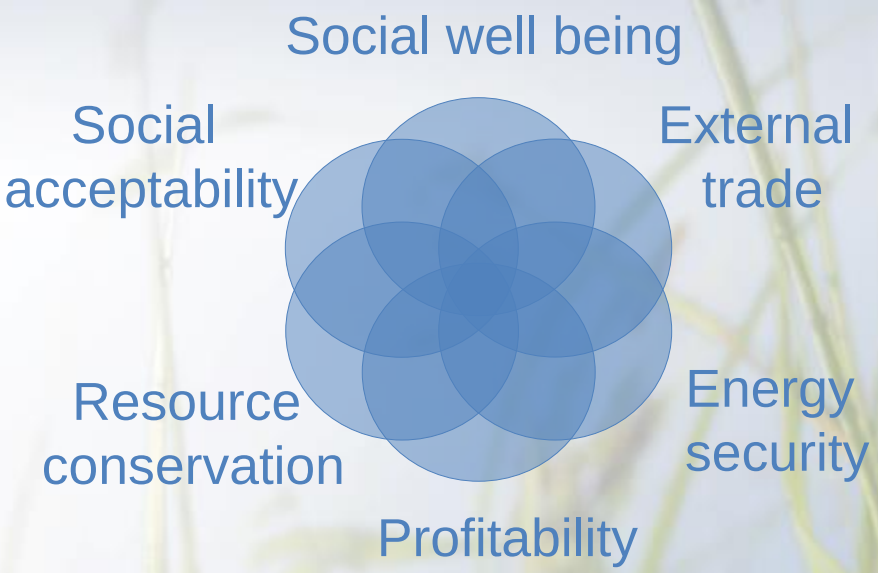
Categories for indicators of environmental and socioeconomic sustainability



McBride et al. (2011)
Ecological Indicators
11:1277-1289.



Dale et al. (2013)
Ecological Indicators
26:87-102.

Recognize that measures and interpretations are <u>context</u> specific

Efroymson et al. (2013) *Environmental Management* 51:291-306.

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Categories of environmental sustainability indicators

Environment	Indicator	Units
Soil quality	1. Total organic carbon (TOC)	Mg/ha
	2. Total nitrogen (N)	Mg/ha
	3. Extractable phosphorus (P)	Mg/ha
	4. Bulk density	g/cm^3
Water quality and quantity	5. Nitrate concentration in streams (and export)	concentration: mg/L; export: kg/ha/yr
	6. Total phosphorus (P) concentration in streams (and export)	concentration: mg/L; export: kg/ha/yr
	7. Suspended sediment concentration in streams (and export)	concentration: mg/L; export: kg/ha/yr
	8. Herbicide concentration in streams (and export)	concentration: mg/L; export: kg/ha/yr
	9. storm flow	L/s
	10. Minimum base flow	L/s
	11. Consumptive water use (incorporates base flow)	feedstock production: m^3/ha/day; biorefinery: m^3/day

Environment	Indicator	Units
Greenhouse gases	12. CO_2 equivalent emissions (CO_2 and N_2O)	kgC_{eq}/GJ
Biodiversity	13. Presence of taxa of special concern	Presence
	14. Habitat area of taxa of special concern	ha
Air quality	15. Tropospheric ozone	ppb
	16. Carbon monoxide	ppm
	17. Total particulate matter less than 2.5µm diameter ($PM_{2.5}$)	$\mu g/m^3$
	18. Total particulate matter less than 10µm diameter (PM_{10})	$\mu g/m^3$
Productivity	19. Aboveground net primary productivity (ANPP) / Yield	gC/m^2/year

McBride et al. (2011) *Ecological Indicators* 11:1277-1289.

Categories of socioeconomic sustainability indicators

Ten minimum practical measures

Category	Indicator	Units
Social well-being	Employment	Number of full time equivalent (FTE) jobs
	Household income	Dollars per day
	Work days lost due to injury	Average number of work days lost per worker per year
	Food security	Percent change in food price volatility
Energy security	Energy security premium	Dollars /gallon biofuel
	Fuel price volatility	Standard deviation of monthly percentage price changes over one year
External trade	Terms of trade	Ratio (price of exports/price of imports)
	Trade volume	Dollars (net exports or balance of payments)
Profitability	Return on investment (ROI)	Percent (net investment/ initial investment)
	Net present value (NPV)[2]	Dollars (present value of benefits minus present value of costs)

Category	Indicator	Units
Resource conservation	Depletion of non-renewable energy resources	MT (amount of petroleum extracted per year)
	Fossil Energy Return on Investment (fossil EROI)	MJ (ratio of amount of fossil energy inputs to amount of useful energy outputt
Social acceptability	Public opinion	Percent favorable opinion
	Transparency	Percent of indicators for which timely and relevant performance data are reported
	Effective stakeholder participation	Number of documented responses to stakeholder concerns and suggestions reported on an annual basis
	Risk of catastrophe	Annual probability of catastrophic event

Dale et al. (2013*) Ecological Indicators* 26:87-102.

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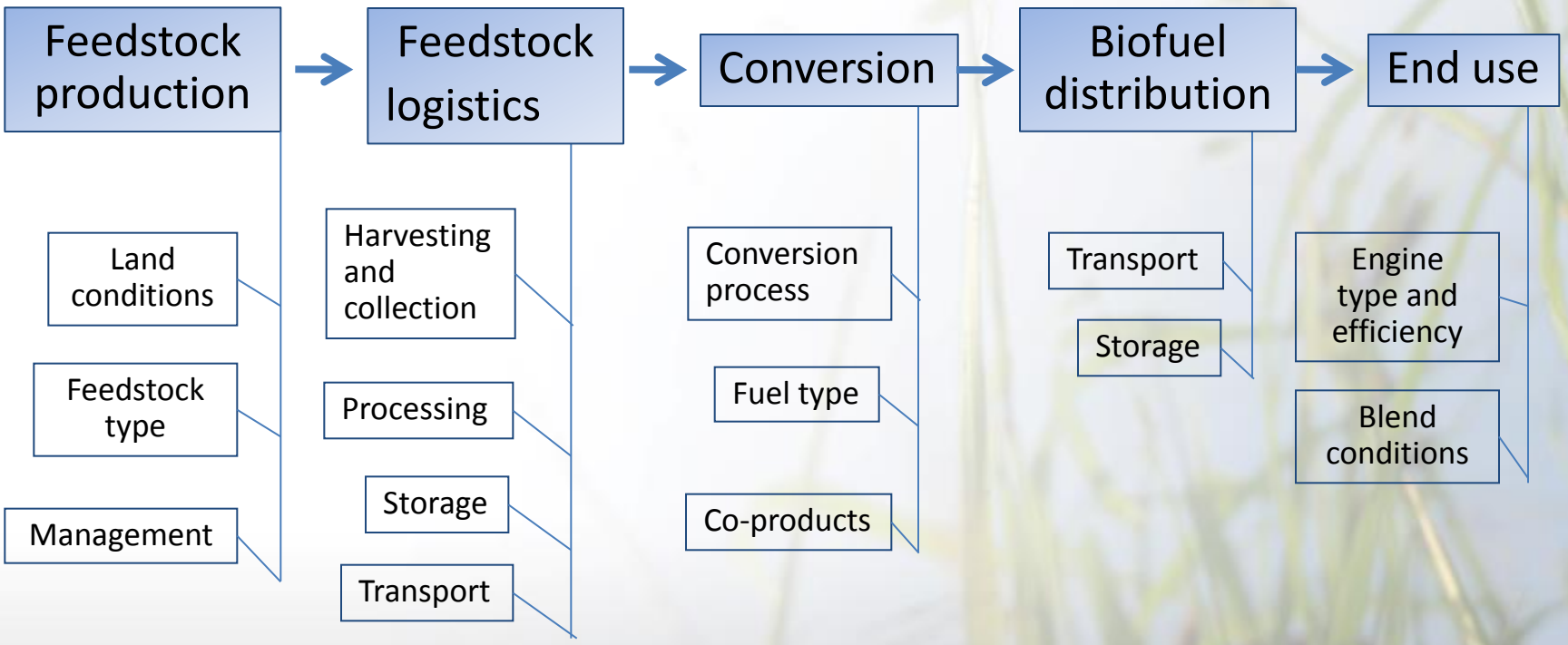
Sustainability Should Apply to

- Entire supply chain
- Diverse feedstocks
- All conversion pathways



(Example shown is biofuel, but concepts are applicable to bioenergy as well)

Dale et al. (2013) *Environmental Management* 51: 279-290.

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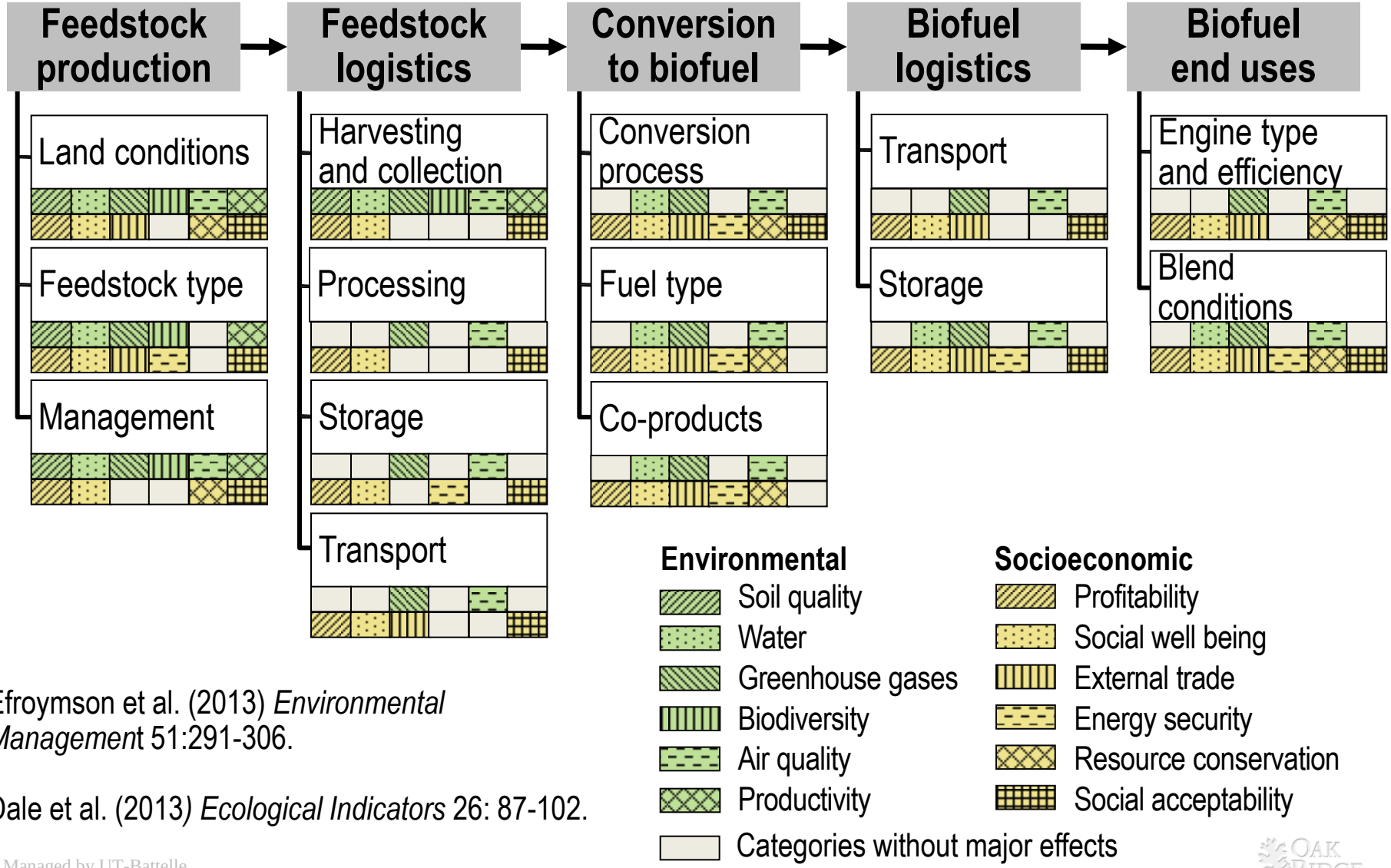
Considered Biofuel Supply Chain in terms of Sustainability Indicators



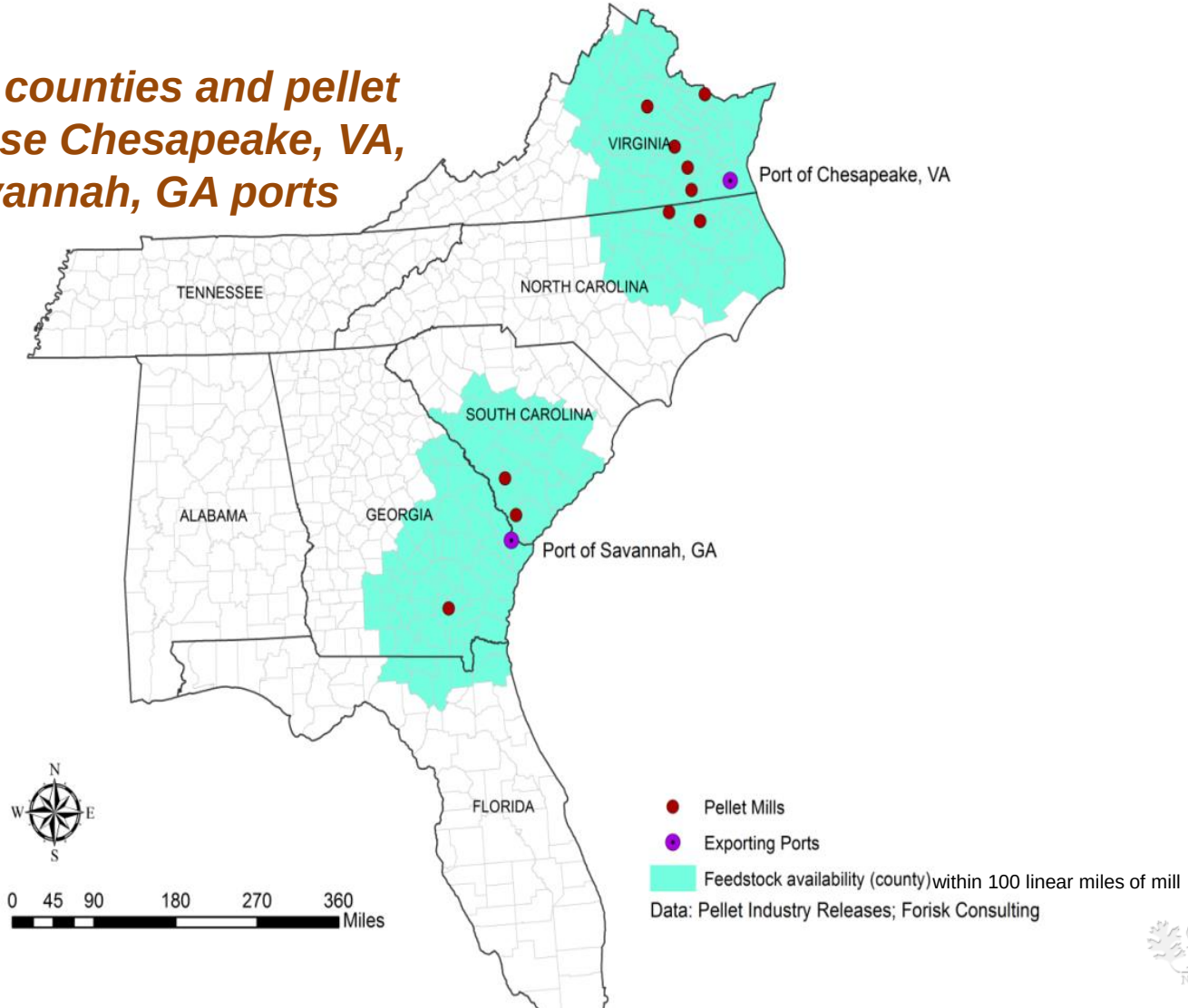
Efroymson et al. (2013) *Environmental Management* 51:291-306.

Dale et al. (2013) *Ecological Indicators* 26: 87-102.

Study focuses on pellet mills feeding two ports

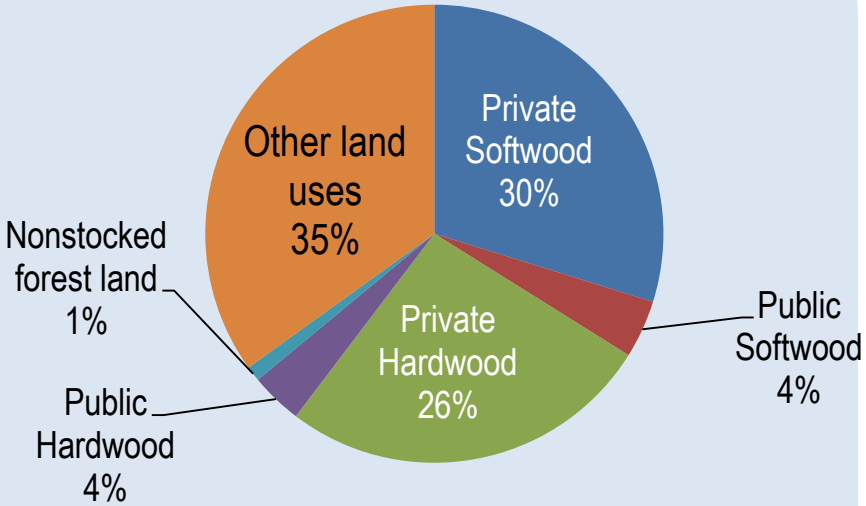
- Savannah
- Chesapeake

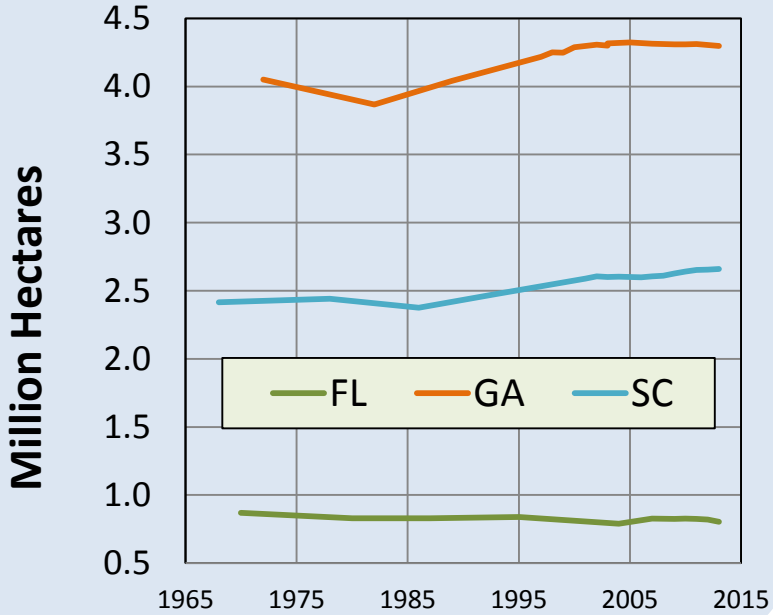
Feedstock counties and pellet mills that use Chesapeake, VA, and Savannah, GA ports



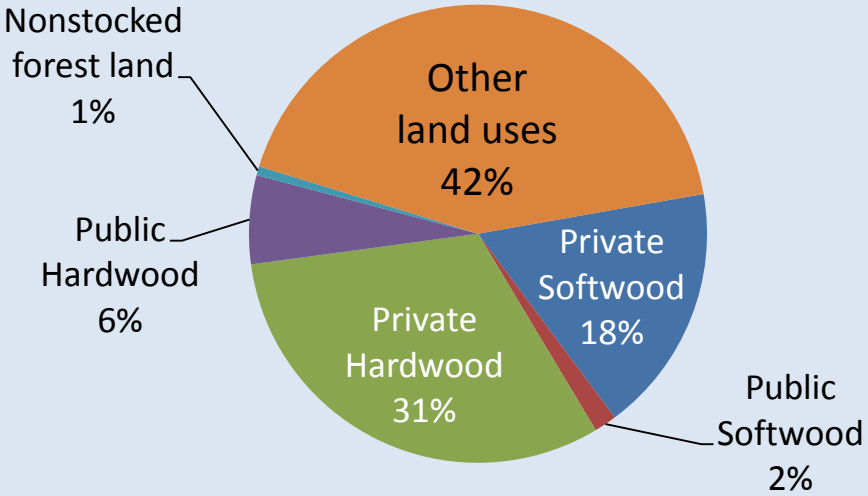
Forest Inventory Analysis (FIA) data for the two fuelsheds

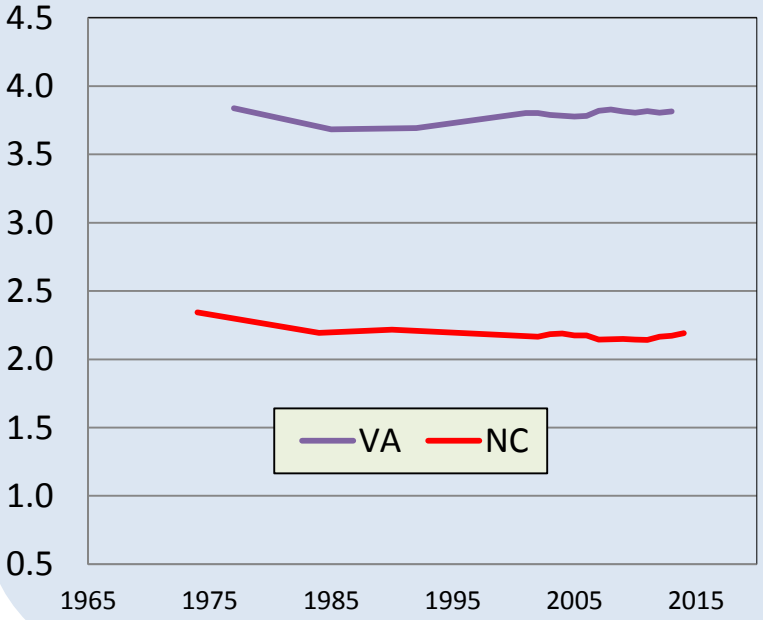
Savannah fuelshed 2013





Chesapeake fuelshed 2013





Conclusions (to date)

- Pellets industry is expanding in SE US but is minor compared to lumber industry
- Forest harvest is primarily driven by demand for lumber
- Sustainability
  - Key concerns:
    - Biodiversity
    - Changes in land use or management
    - GHG – requires
      - Realistic reference conditions
      - Appropriate time scales
  - Potential opportunities
    - Jobs
    - Water quality improvement
    - Preserving land as forests
    - Certification for sustainability
      - Corporate lands: Certified lands
      - Non-corporate lands: Certified loggers
- Need to communicate environmental opportunities and concerns to stakeholders

Thank you!

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