An evaluation of the erosion potential and the implementation of forestry best management practices in the Southeastern US

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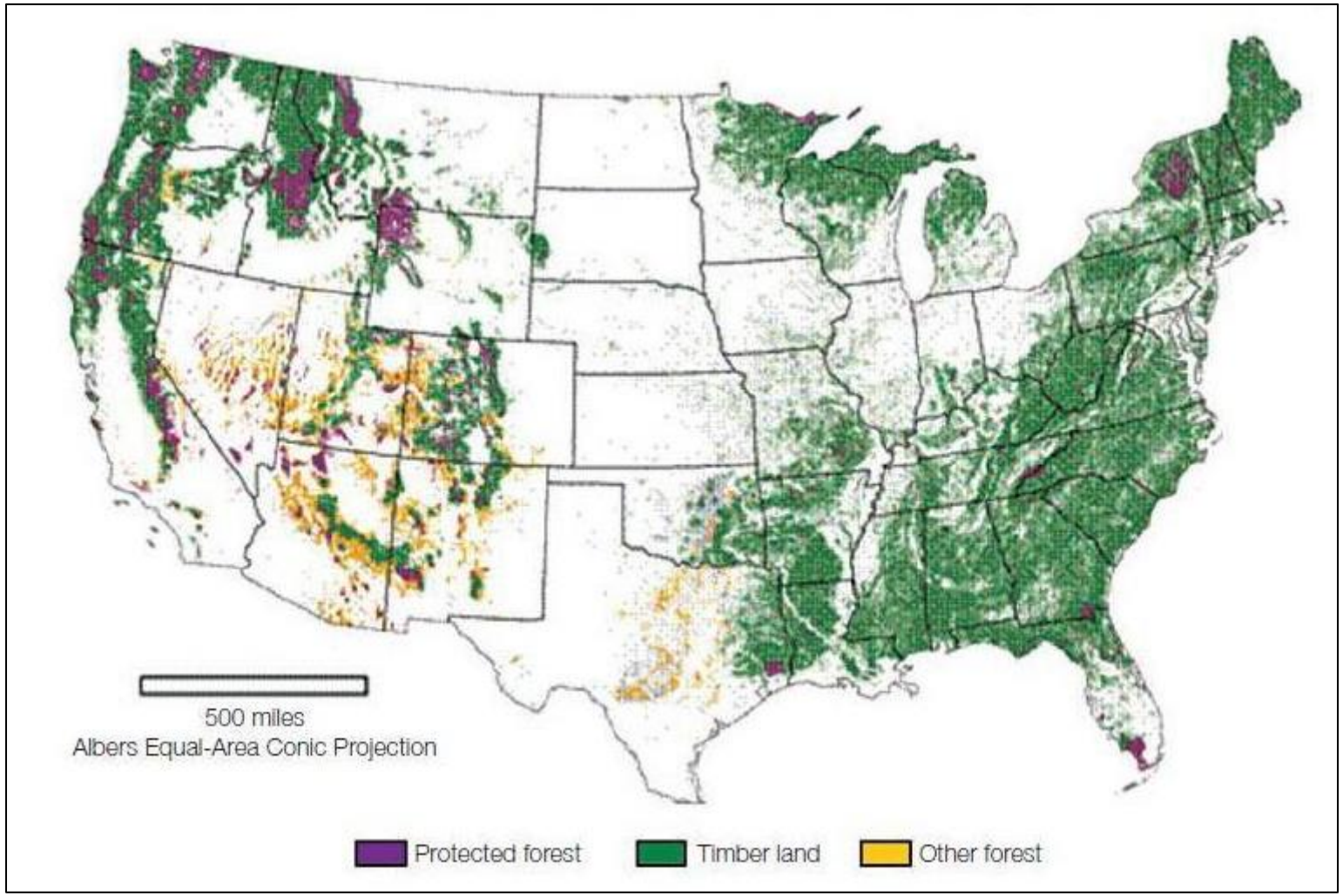
Introduction

- 33.87% of the US territory is forested (World Bank, 2020).

- About 60% of the timber harvested in the US comes from the southern regions (Staudhammer et al., 2011).



Source: USDA, 01/29/2018

Harvesting system

1) Conventional system

- Feller buncher, skidder, and loader
- Only merchantable timber is used

2) Integrated biomass system

- Integration of in-wood chipper into the conventional system

Conventional system

Logging residues & SDT

Left on the forest floor

Sawtimber & Pulpwood

Market

Biomass system

Sawtimber & Pulpwood

Logging residues & SDT

In-wood chipping

Wood chips

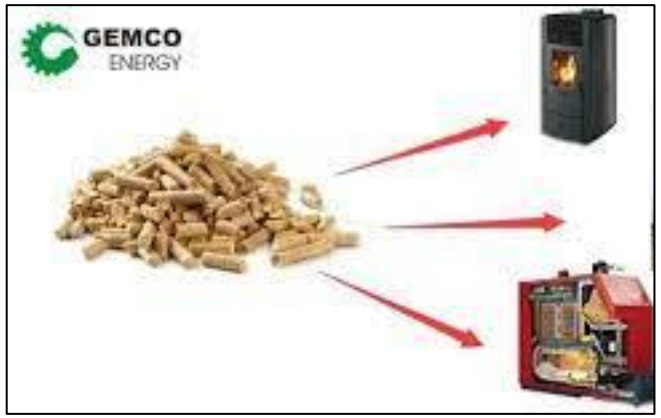
Bioenergy market

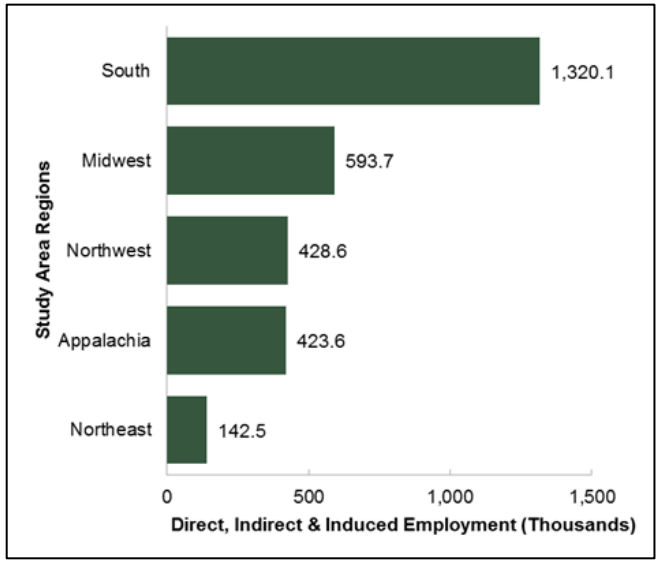
SDT= Small Diameter Trees

- The Southern US can yield 32 million tonnes of dry logging residues annually (Eisenbies et al., 2009).

Potential impacts of timber harvesting

4% of the US manufacturing GDP comes from the forest products industry. Over $200 billion in products annually (Oswalt, 2021).





Over $55.4 billion in direct payroll (Forest2Market, 2019).

Non-point source pollution such as soil erosion and sedimentation. Affects drinking water, and harms aquatic life (Cristan et al. 2018).

Forestry best management practices (BMPs)

- Clean Water Act, 1972 recognizes the implementation of BMPs as the most effective tool to address nonpoint source pollution (Cristan et al. 2018).

- Potential impacts of timber harvesting depends upon BMP implementation status.


Temporary bridge


Slash over skid trail


Gravel in forest road


Water bar

Objectives

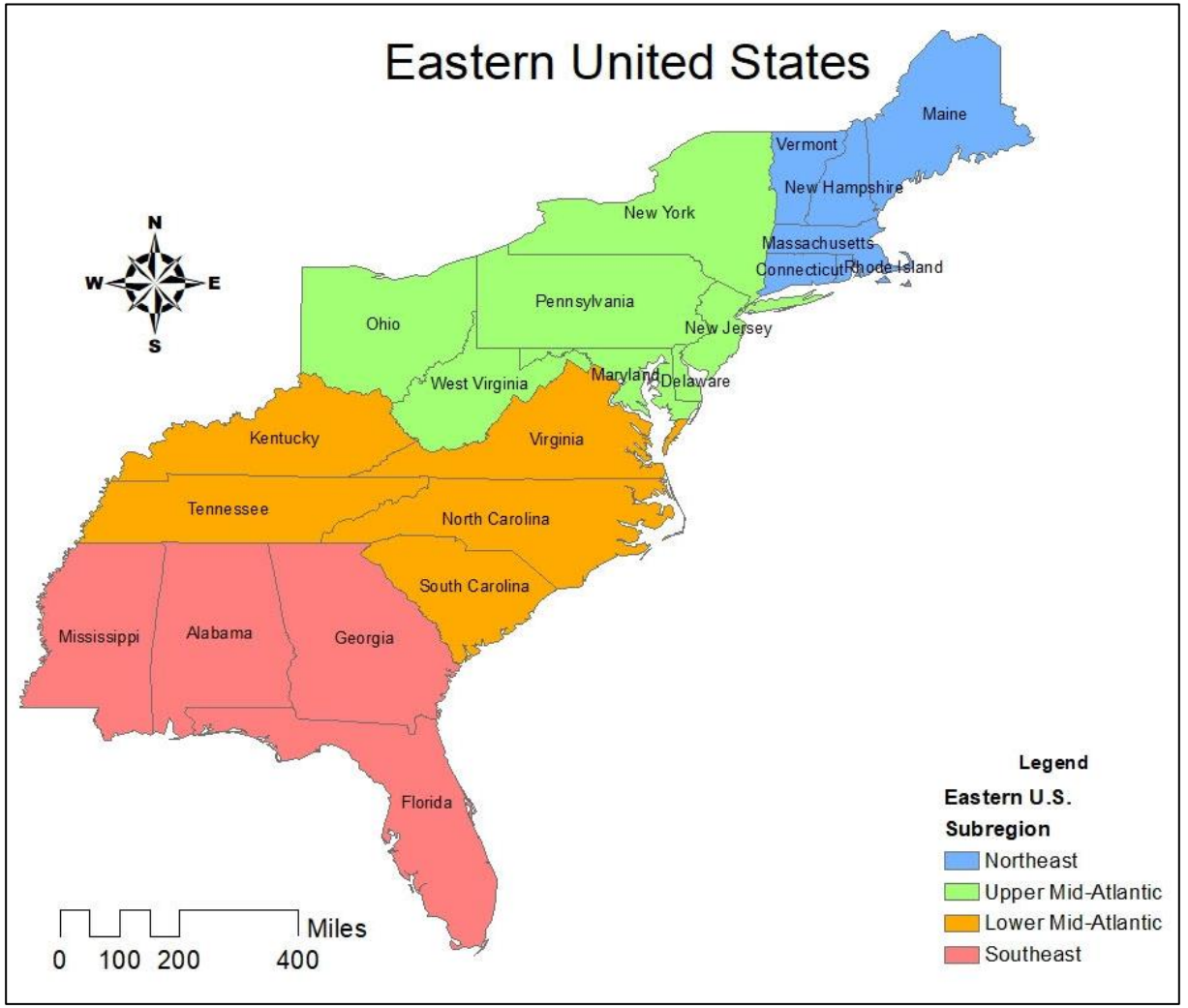
1) To evaluate post-harvest site conditions and estimate the potential erosion rates from conventional and biomass sites.

2) To compare BMP implementation status between conventional and biomass harvest sites.

Methodology

Study area

- Collaboration with researchers at three other Universities: West Virginia University, Virginia Tech, and the University of Maine.



Southeastern region

Location

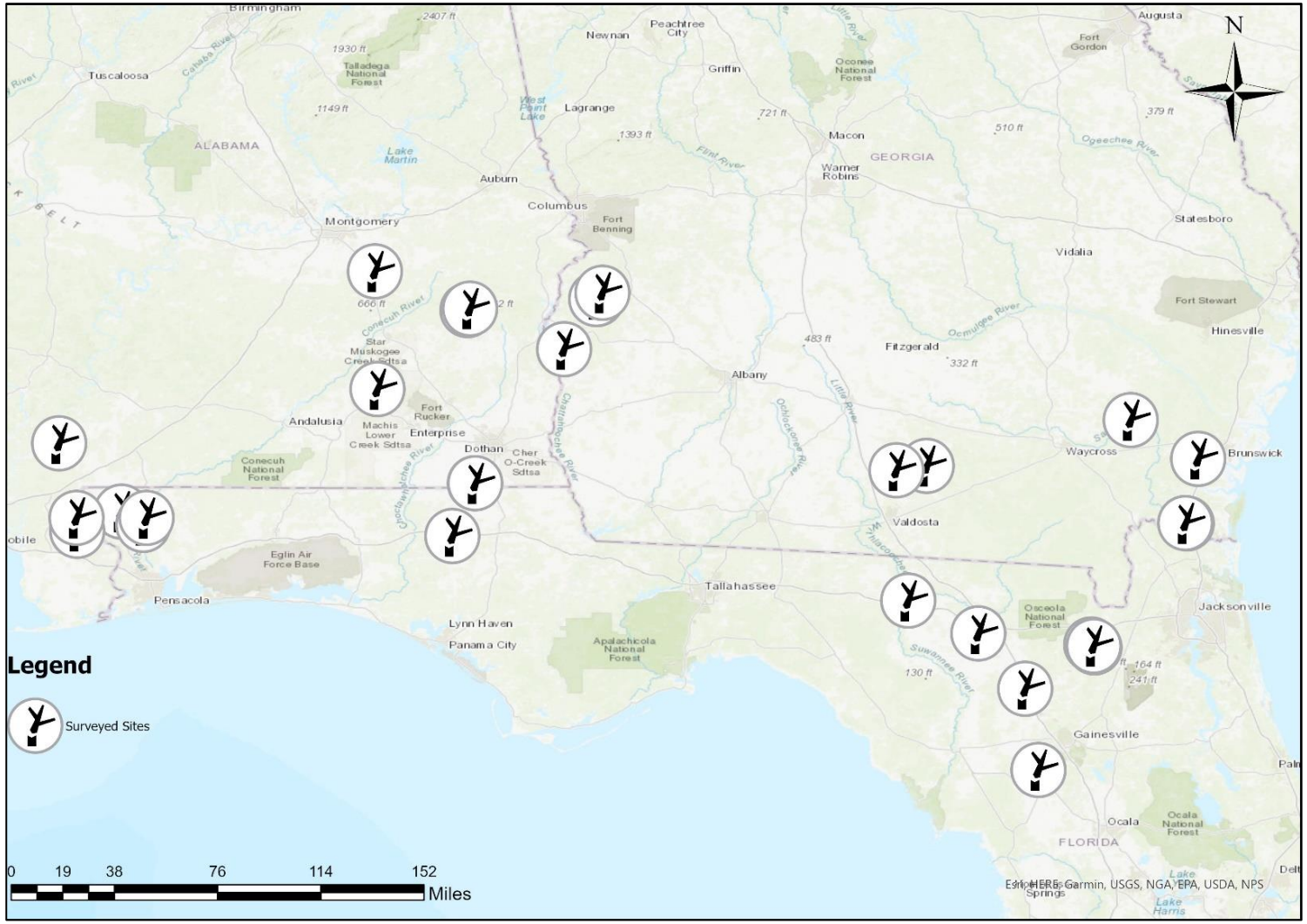
- Coastal regions of Alabama, Georgia, and Florida

Site selection

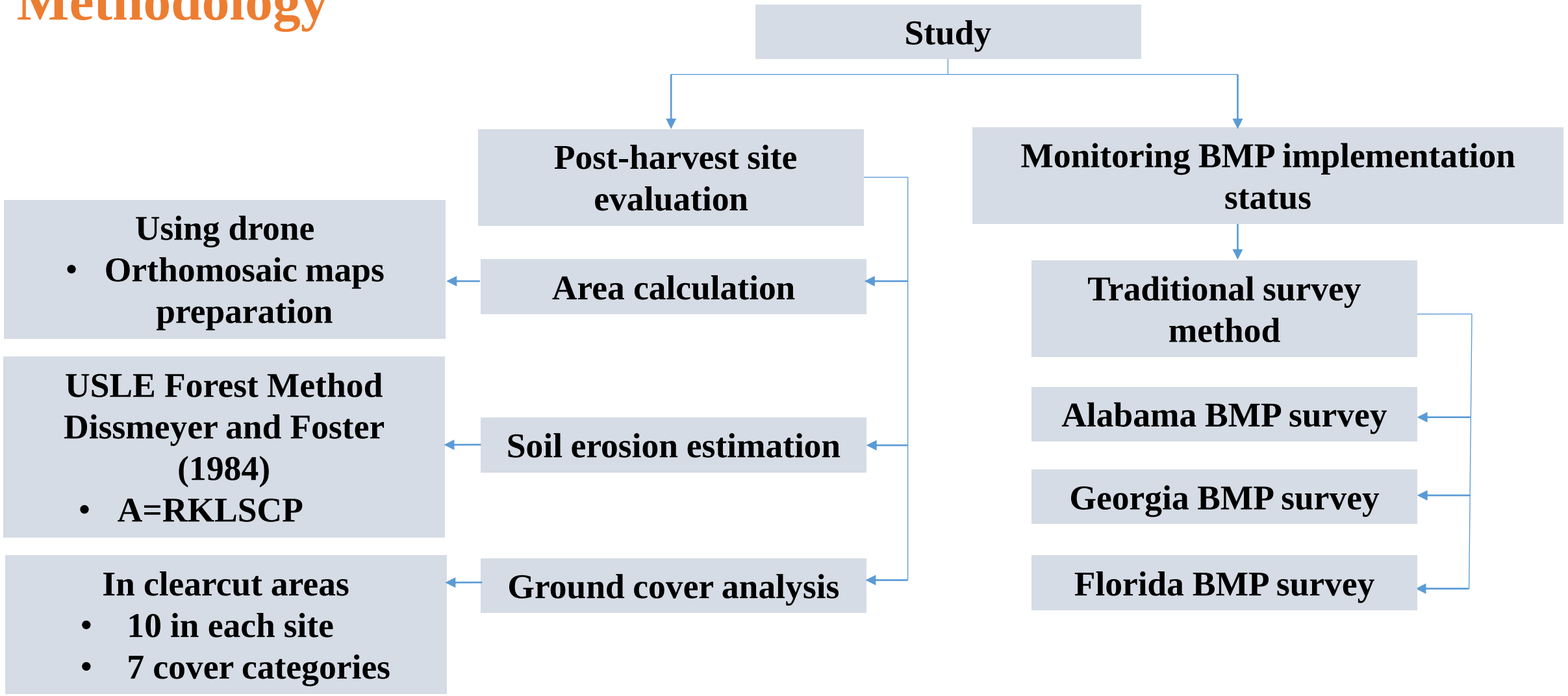
- Harvested within 1 year

Sample size

- 15 biomass and 15 conventional harvest sites in each state
- N=30



Methodology



Flowchart of the methodology

1) Soil erosion estimation

6 operational categories

a) Forest roads (3 estimates)

b) Decks or landings (2 estimates)

c) Skid trails (3 estimates)

d) Streamside Management Zones (SMZs) (3 estimates)

e) Stream crossings (2 estimates in each crossing)

f) Clearcut areas (10 estimates in each clearcut)

a)


b)


c)


d)


e)


f)


Universal soil loss equation (USLE-Forest)

- Dissmeyer and Foster (1984)

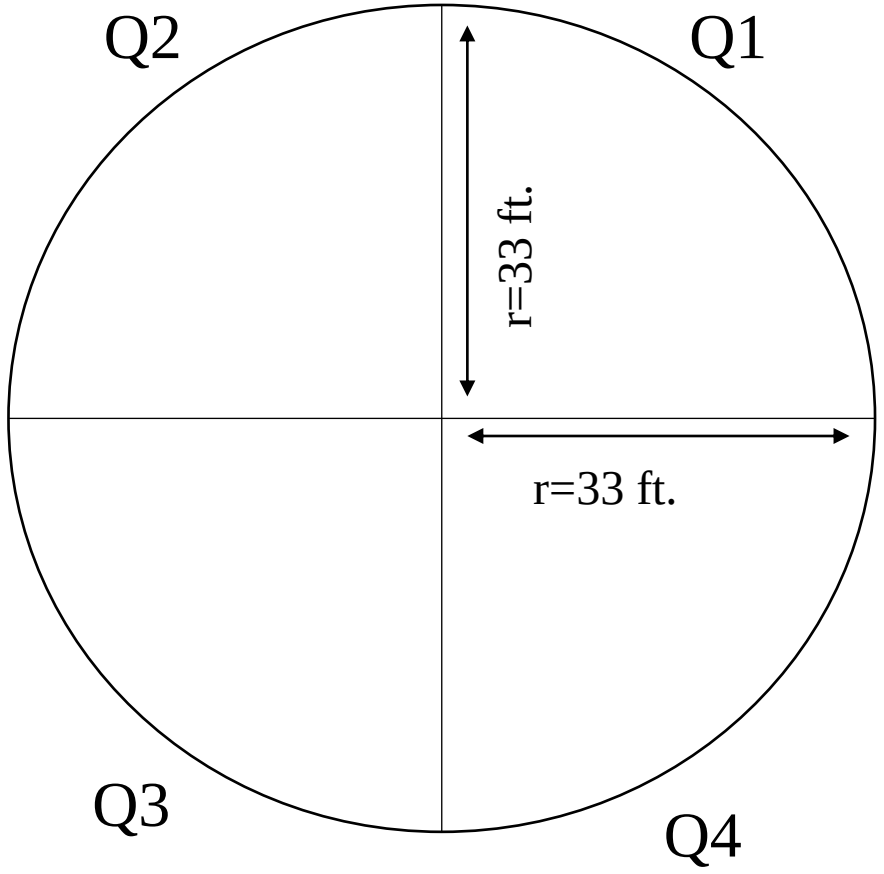
A= R*K*LS*CP

A= Estimated erosion per unit areas (tons/acre/year)
R= Rainfall or runoff factor
K= Soil erodibility factors
LS= slope length and slope steepness factors
CP= cover and management practices factors

- Slope length = 66 ft
- Distance between two points =132 ft

2) Ground cover analysis

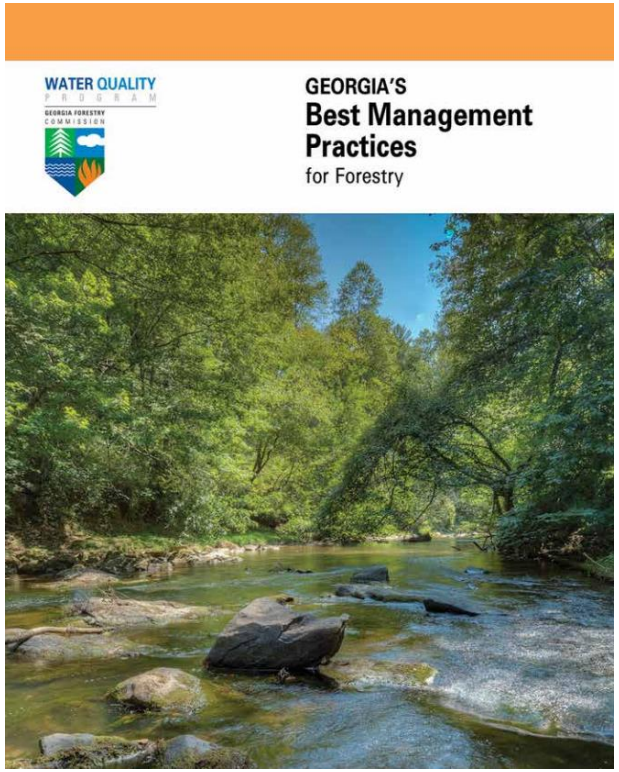
- In clearcut areas
- N=10 per site

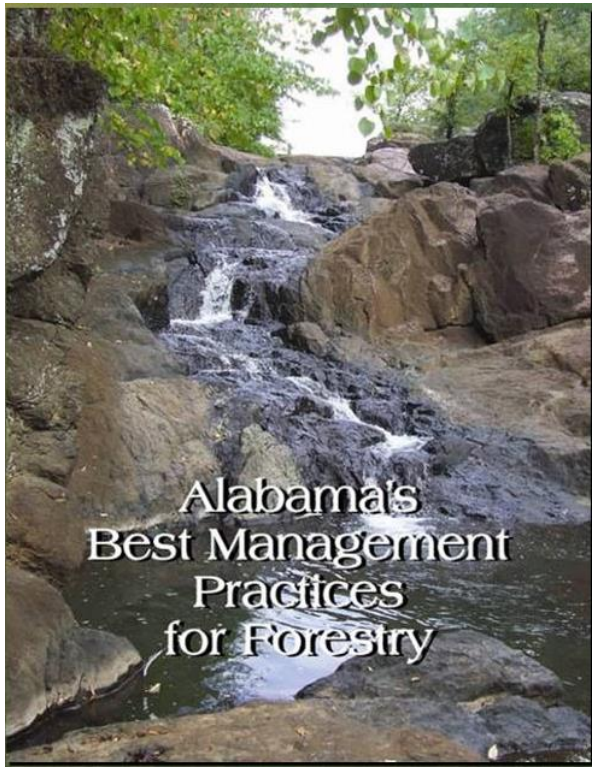


Categories	Quadrants				Average
	Q1	Q2	Q3	Q4	
1) Bare soil					
2) Rocks					
3) Piles of woody debris (>1 foot deep)					
4) Light slash (<1 inch diameter)					
5) Heavy slash (> or equal to 1 inch diameter)					
6) Litter					
7) Green growth					

3) BMP implementation audit score

- BMP guideline of each state
- 5 categories (Timber harvesting, SMZs, forest roads, stream crossings, waste disposal).
- Field evaluations consist of answering “yes”, “no”, or “not applicable”.
- Implementation rate= total number of yes / (total number of yes + no) expressed as a percent, for the site.

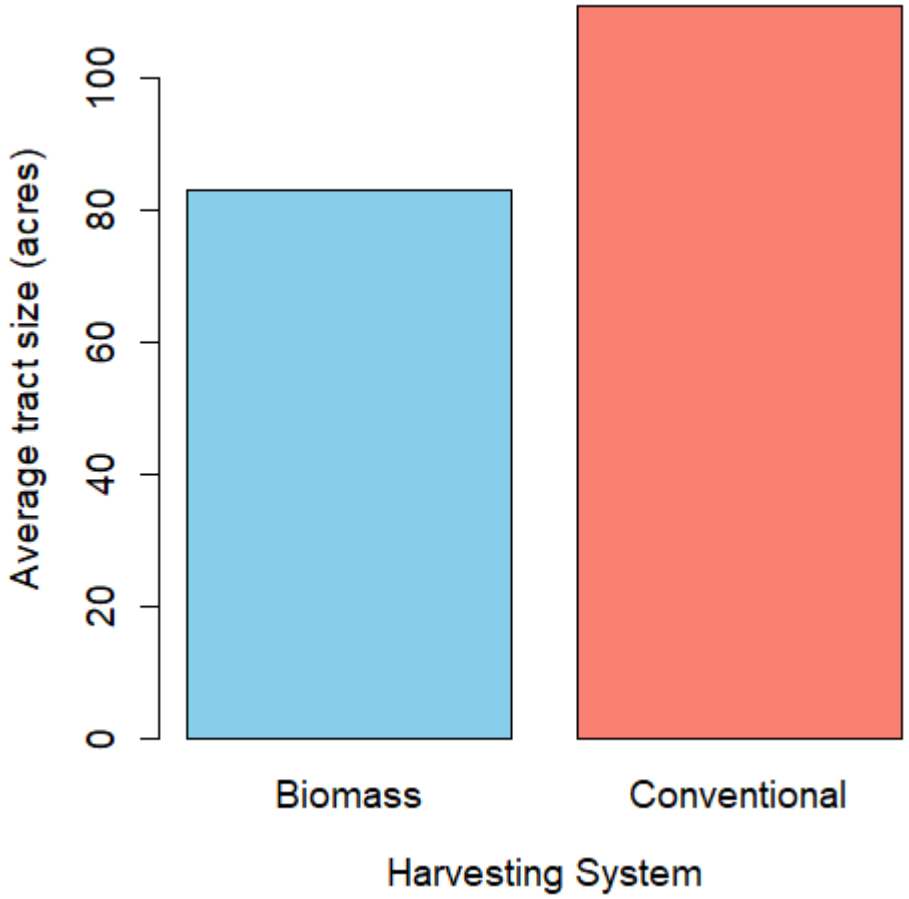




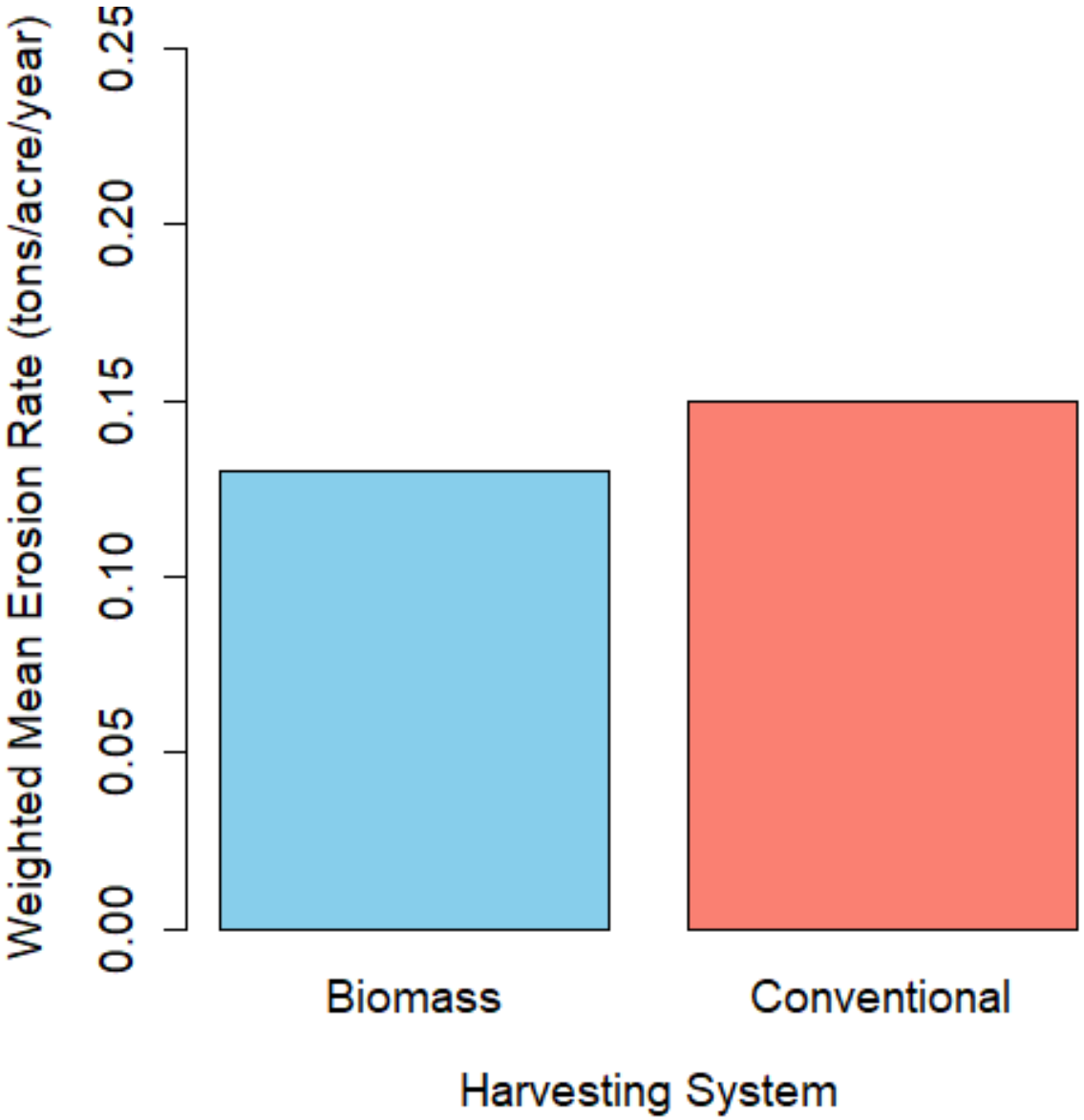
Results

Welch Two Sample t-test

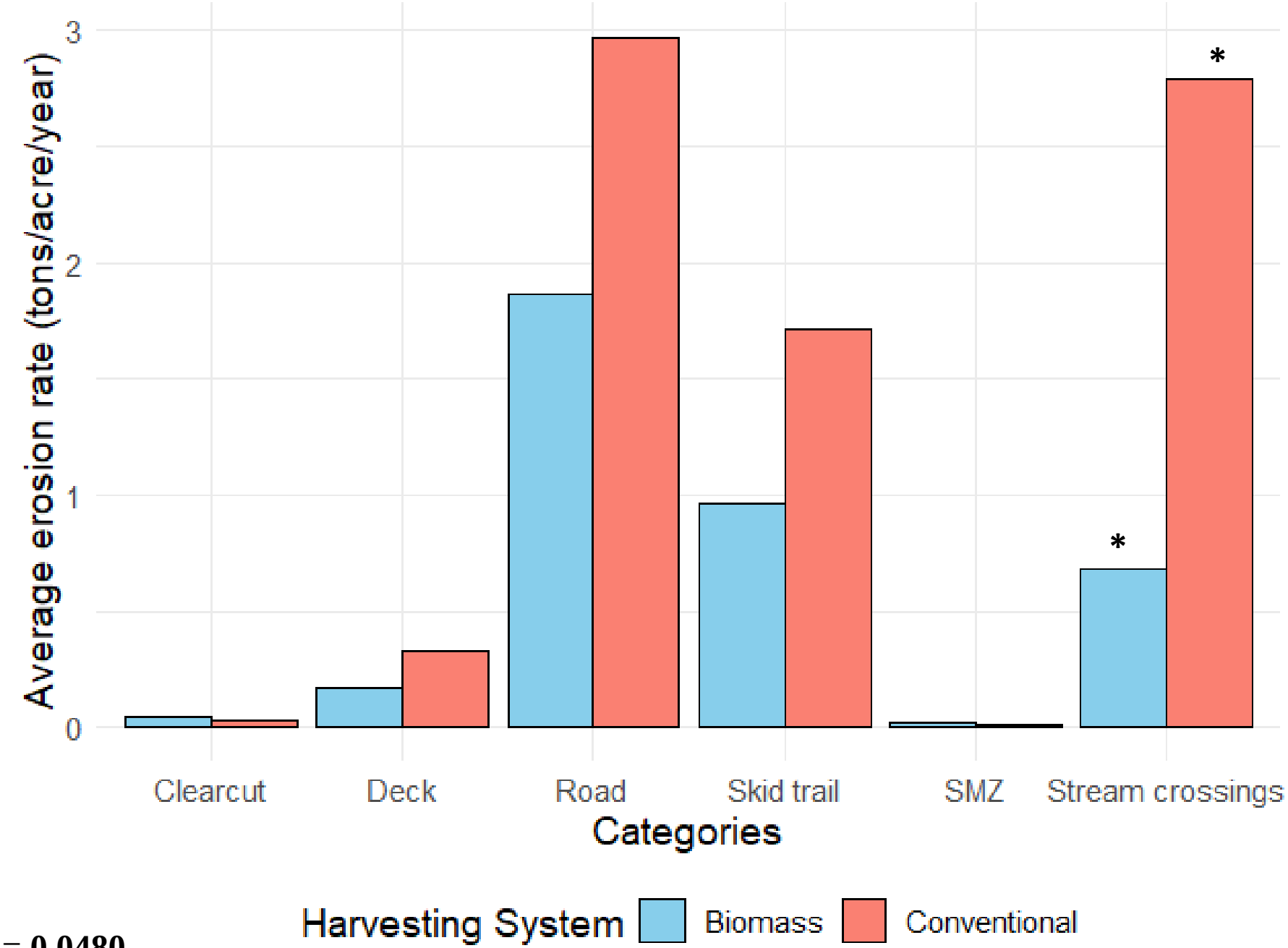
t = -2.0567, df = 29.817, *p*-value = **0.0485**



t = -0.1622, df = 27.906, *p*-value = 0.8723

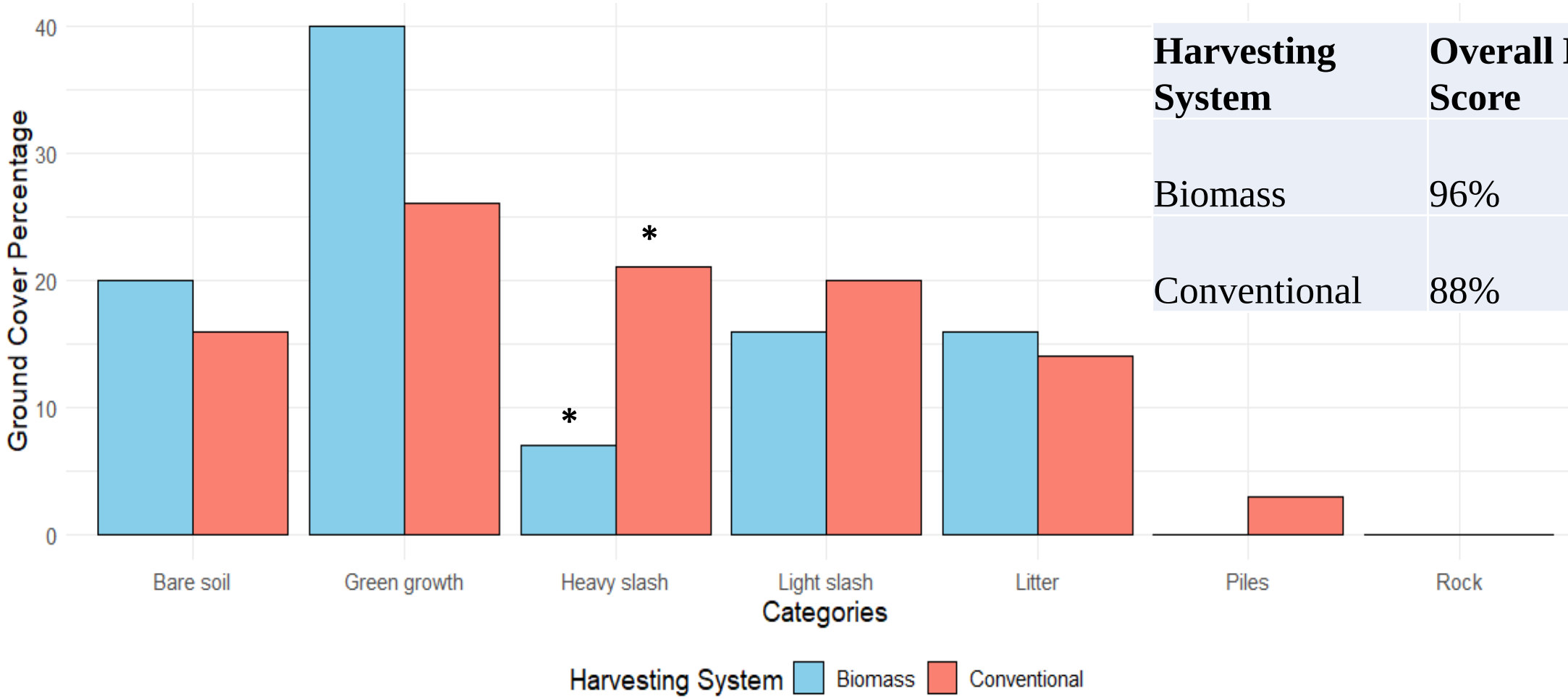


Results



t = -2.6306, df = 4.7506, *p*-value = **0.0480**

Results



Harvesting System	Overall BMP Score
Biomass	96%
Conventional	88%

Conclusion

- The mean size of tracts harvested using Conventional method was significantly higher that of tracts harvested using biomass methods.

- While the weighted mean erosion rate from Conventionally harvested sites was a bit higher than that from biomass harvested sites, this difference was not statistically significant.

- For both Conventional and Biomass systems, the greatest estimated erosion rates were observed on roads and skid trails. In contrast, the lowest estimated erosion rates were found in SMZs. Notably, the mean erosion rate from Conventional harvest sites was significantly higher at stream crossings.

- In the biomass system, even though some logging slash was used for fuel, substantial amounts of it remained on site.

- Ensuring the implementation of appropriate BMPs at all harvest sites is crucial, irrespective of the harvesting method employed.

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Questions?

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