THE UNIVERSITY OF MAINE

SFR-400 Final Project

Forest Cover Dynamics over 23 years in Maine

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Introduction

Introduction

- Forests are a critical component of the global carbon cycle
- Maine: Timber production/ harvesting (area/$)
- In Maine, the forest product industry accounts for nearly 4.2% of the state's gross domestic product (J Zhao et al., 2022)
- Around 77% of forest cover in Maine State experienced disturbances in the past two decades due to various agents (Kosiba et al., 2018): reasons!!!

Introduction

- Climate change can threaten the function and productivity of forest ecosystems.
- In water-deficient forest ecosystems, heightened precipitation can stimulate timber production, while a wetter climate can inhibit photosynthesis and impede tree growth in water-sufficient regions ecosystems (Hansen et al., 2017)
- Tracking changes in land use is important for analyzing factors affecting forest loss (diversion) and forest gain (reversion).

Objectives

Objective

- Measure and visualize the extent of county-wise forest cover change from 2000 to 2023
- Analyze the factors of forest change, including climate, and socio-economy
- Analyze forest fragmentation, which affect the biodiversity and ecosystem functions

Data and Methods

Data Sources

Data	Year	Resolution	Data Sources
Tree Canopy Cover	2000	30m	Earth Engine Partners
Tree Loss and Gain Year	2000-2023		
Mean Annual Precipitation	1981-2023	4000m	PRISM[1] Climate Group
Mean Monthly Temperature			
Digital Elevation Mode (SRTM[3])	2000	30m	USGS EROS[2] Centre
Land Use Land Cover	2017-2023	10m	ESRI LULC[5] data
Maine Road Feature	2024	Vector	Maine GIS

Table 1. Information of the Dataset

[1] Panchromatic Remote-sensing Instrument for Stereo Mapping, [2] Earth Resources Observation and Science (EROS) Center, [3] Shuttle Radar Topography Mission, [4] Environmental Systems Research Institute, [5] Land Use Land Cover

Study Area

The study was conducted in Maine, USA.
Total area:
Climate zones:
Major Species:

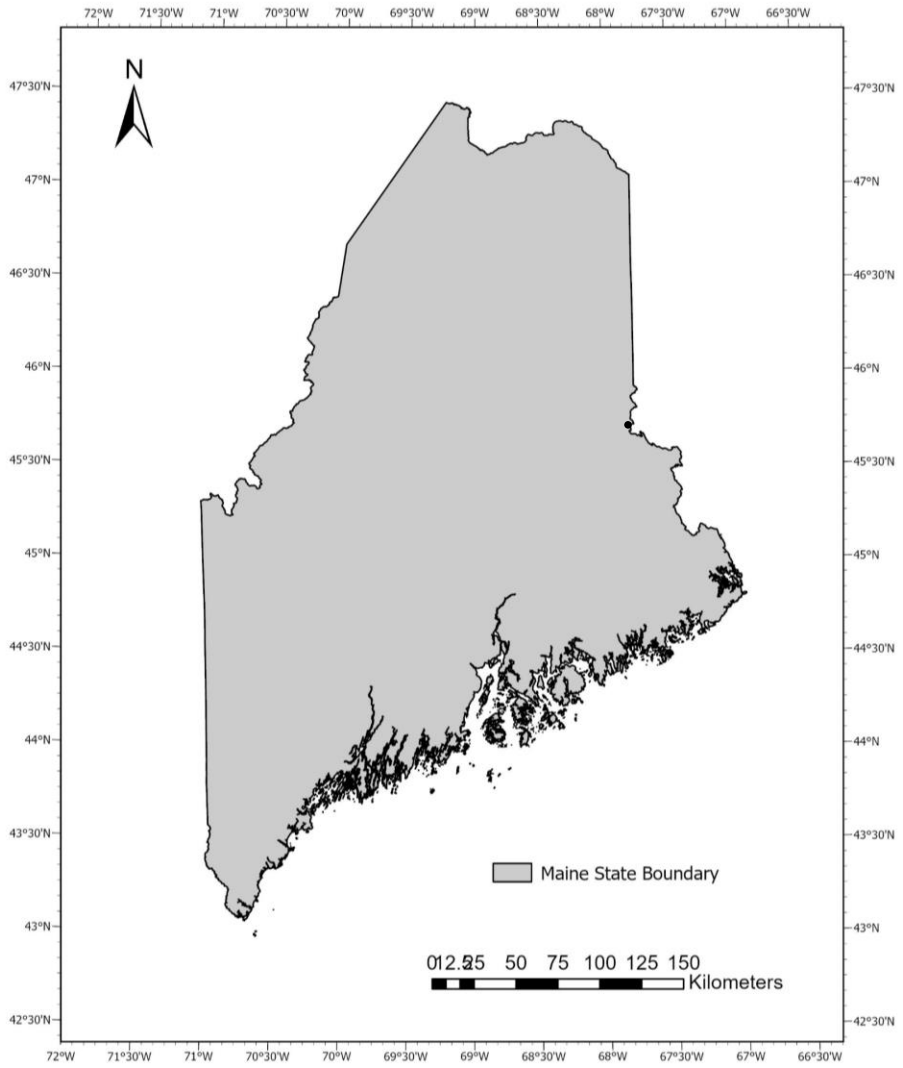

Figure 1. Study Area Map

Methodology

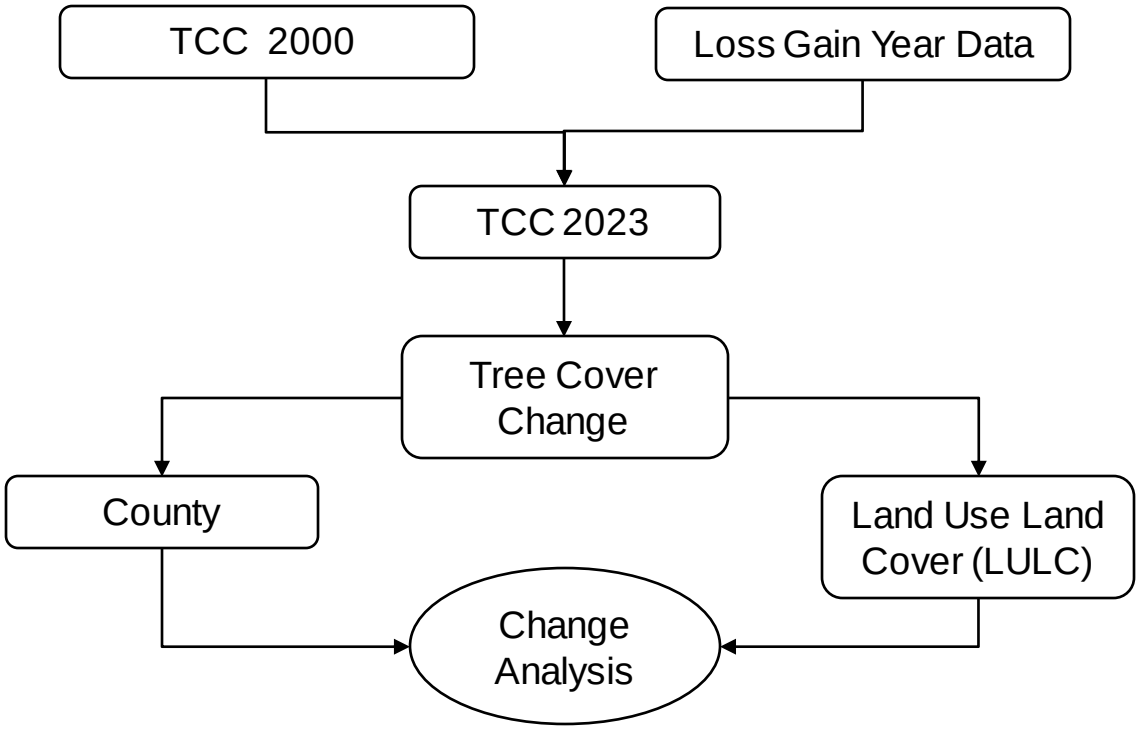

Figure 2. Forest Change Analysis Flow

Data and Methods

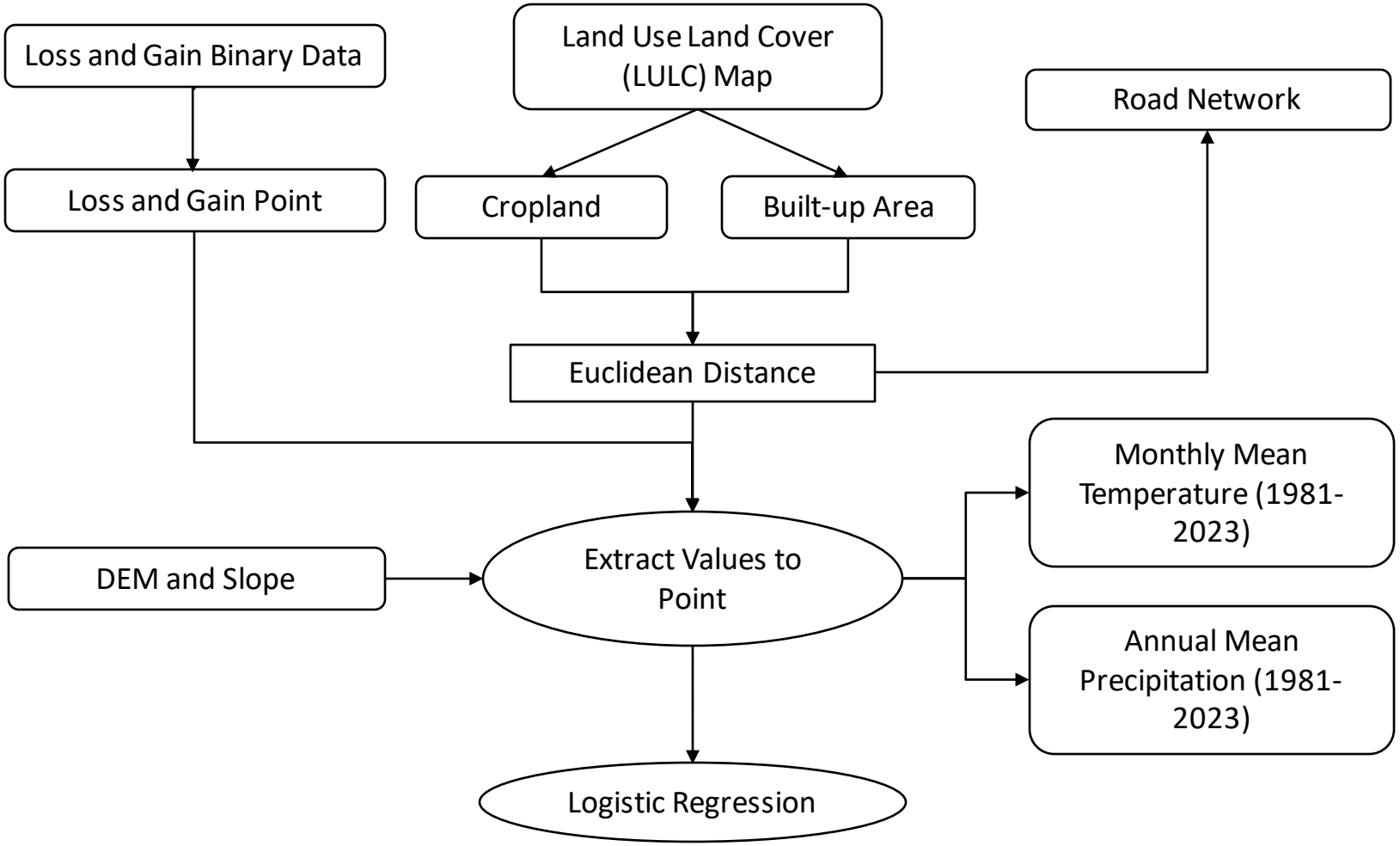

Figure 3. Forest Change Drivers Analysis Flow

Data and Methods

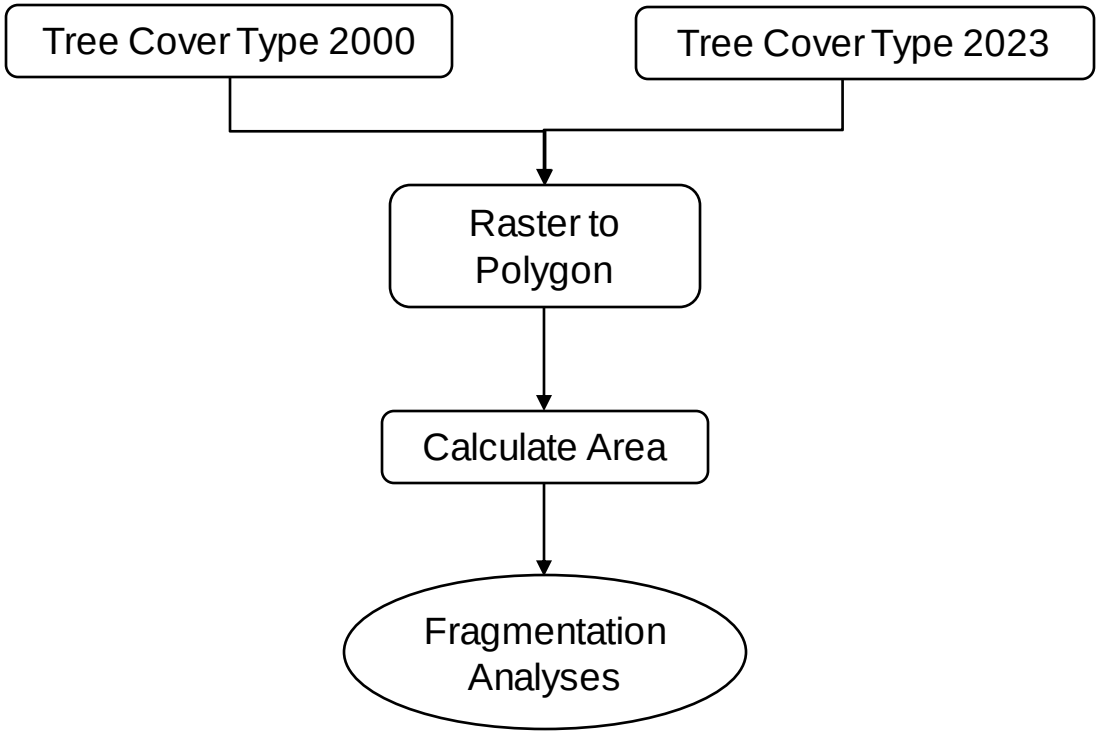

Figure 4. Forest Fragmentation Analysis Flow

Results

Results

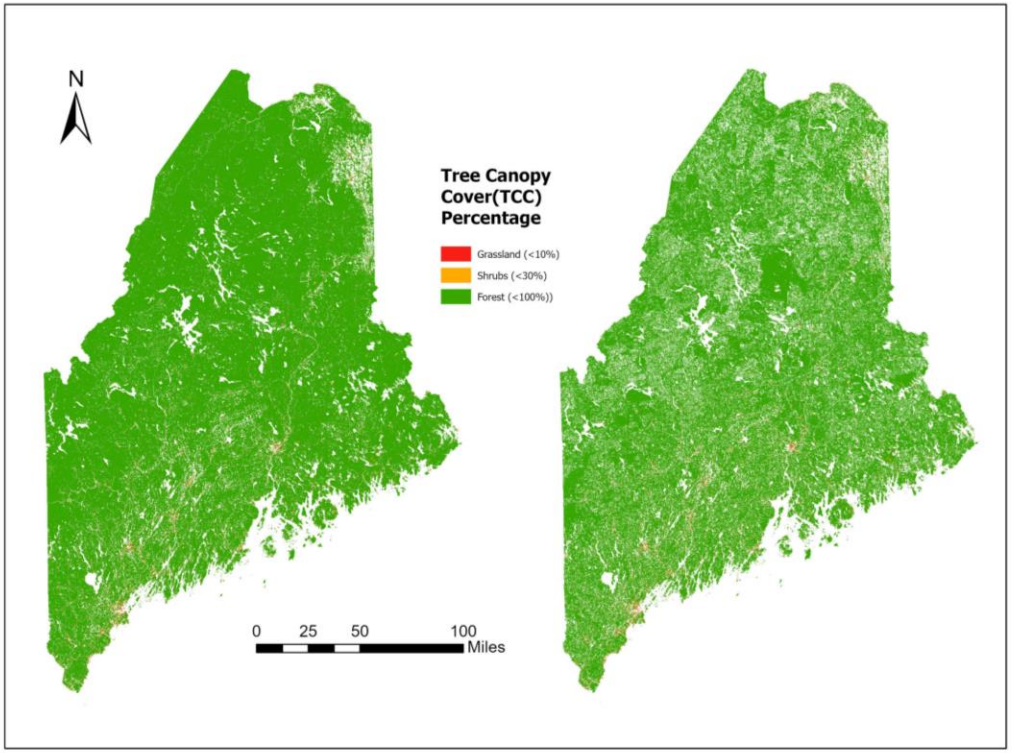

Figure 5. Tree Canopy Cover (in %) in 2000 and 2023

	2000	2023
Total Forest Area	17.90 million acres	15.17 million acres
% Forest Area	86%	73%
% Shrubs Area	0.016%	0.0148%
% Grassland Area	0.006%	0.005%

Compared to 2000, Maine
lost about 15% forest land till 2023

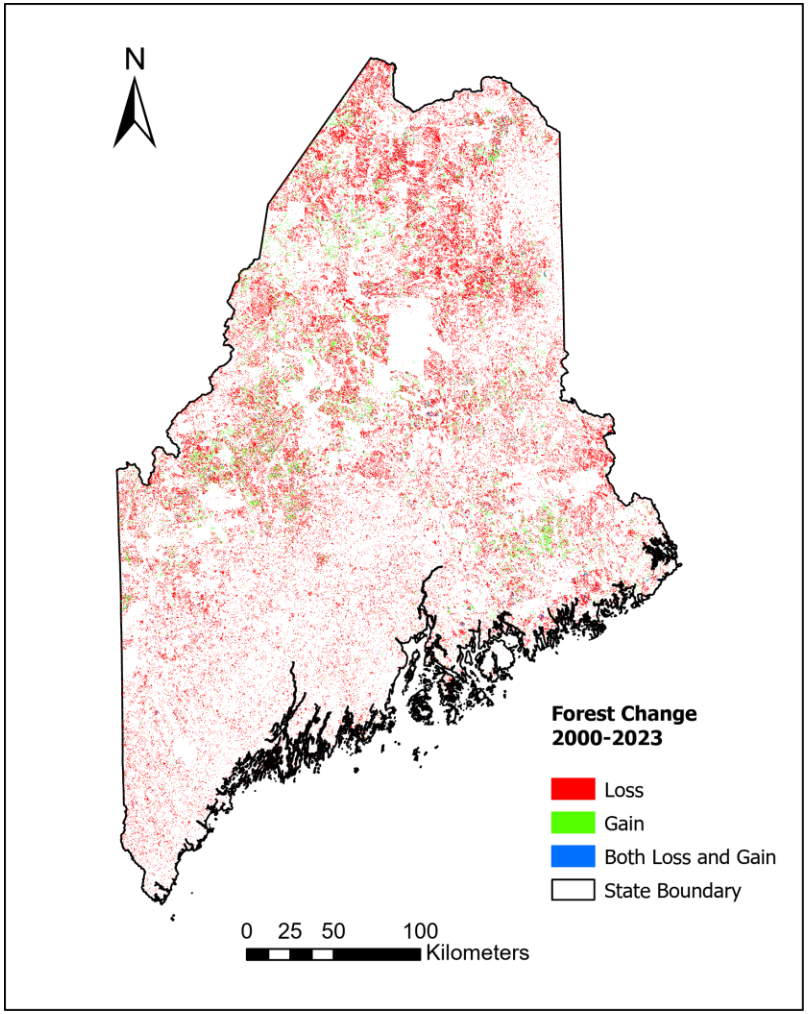

Figure 6. County Wise Forest Change Assessment

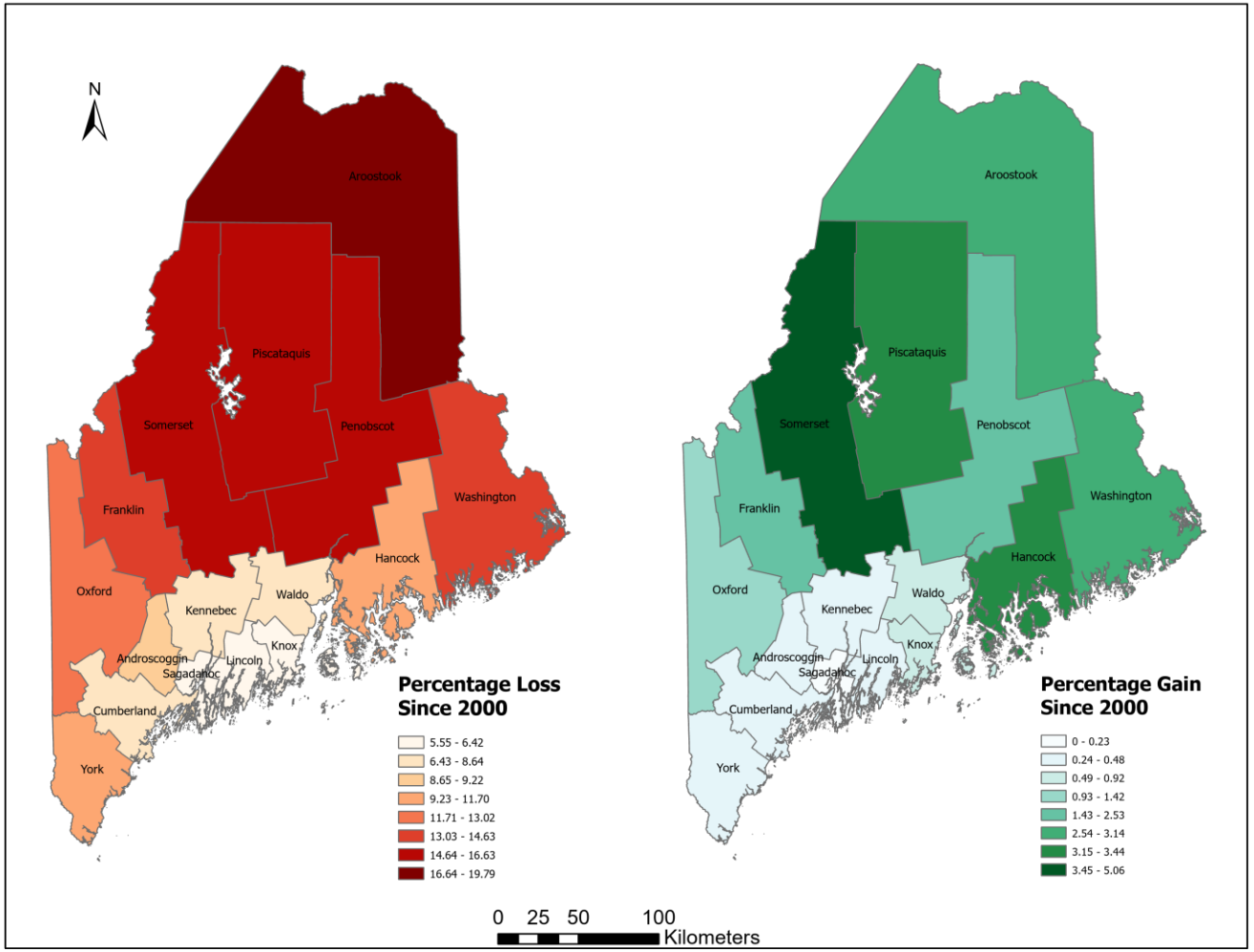

Figure 7. County Wise Forest Change Assessment

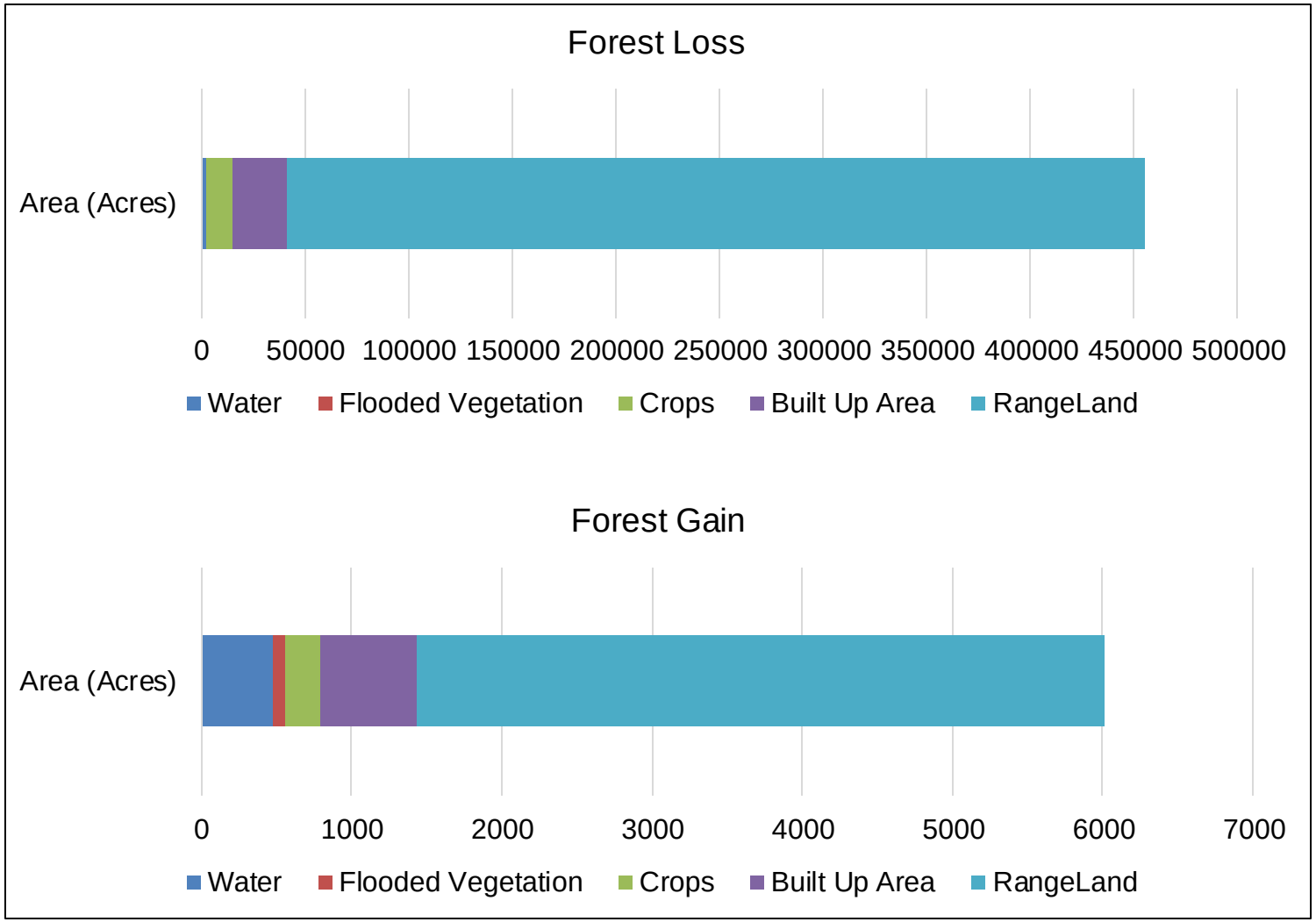

Figure 8. Gross area of forest loss and forest gain by land use category

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Results

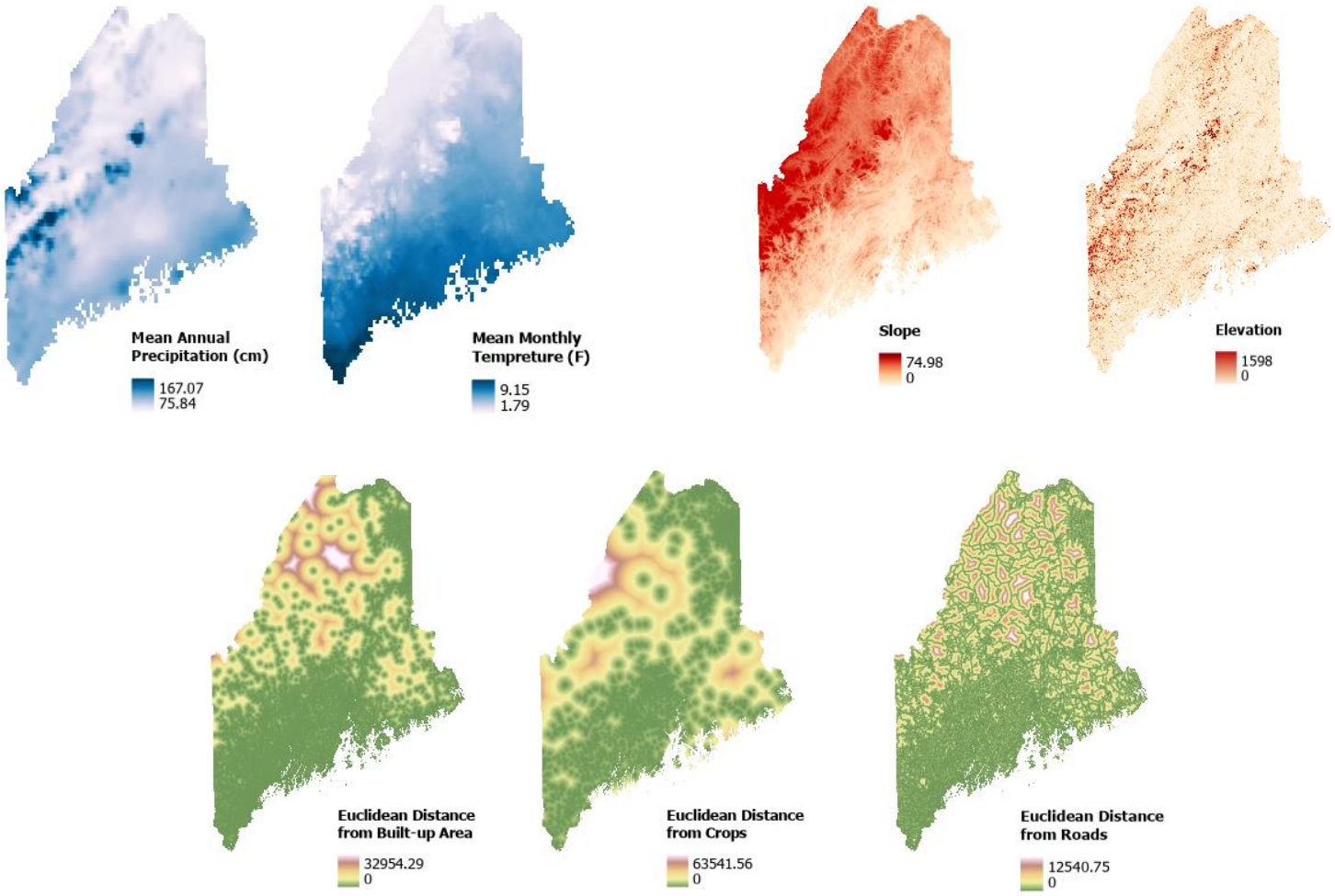

Figure 9. Forest Loss Factors taken for the study

Results

Table 2. Driver wise β-coefficient and their corresponding significance level as derived from logistic regression for TCC gain and loss

Driver	β-coefficient	Significance level
Distance to Crop	-8.224e-06	0.009
Distance to Built-up Area	1.234e-05	0.028
Distance to Road	3.744e-05	0.051
Average Monthly Temperature	0.0169	0.000
Average Annual Precipitation	-0.0167	0.000
Elevation	0.0013	0.000
Slope	0.0001	0.217

[1] β -coefficients at <0.005 level are considered significant. If a coefficient is negative, it means that as the corresponding feature increases, the log-odds of the target variable decrease

[2] Significance level of 0 indicates that the observed effect is highly unlikely to occur by chance

Table 3. Area-weighted mean of patch size, total number of patches, maximum patch area value for the year 2000 and 2023

Tree Cover Type	Year	Total No of Patches	Mean Patch Area (Acre^2)	Maximum Patch Area (Acre^2)
Forest	2000	83,563	214.9	1,72,50,360
	2023	391,204	2.23	56,719
Shrubs	2000	8,35,805	0.24	158
	2023	7,78,061	0.24	157
Grassland	2000	3,74,137	0.19	62
	2023	3,44,199	0.19	62

Conclusions

Conclusions

- Maine lost a significant area of forest land, accounting for around **15% of** forest loss from 2000 to 2023
- **Aroostook** county has the highest forest loss whereas **Somerset** county has the highest forest gain among all the counties
- Among various land use categories, **Rangeland** covers the most forest loss area, followed by **the Built-up** area, indicating a significant forest area was converted into a Built-up area
- Moreover, variables such as Distance to Crop, Elevation, Temperature and Precipitation showed a significant relation with forest loss.
- Mean forest patch area has significantly reduced from 214 $acre^2$ to 2 $acre^2$ during 2000-2023 indicating possible **biodiversity loss and ecosystem degradation** (Jun Ma, et al., 2023)

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Thank you!