

Supplementary Materials

Identification of Land and Potential Production of Willow Biomass Crops Using a Multi Criteria Land Suitability Assessment

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Table S1. Low carbon fuels production target in NYS's Scoping Plan (in TBtu) [1,2]

Fuel	Strategic Use of Low-Carbon Fuels (SULCF)		Accelerated Transition Away from Combustion (ATAC)		Beyond 85% Reduction	
	2030	2050	2030	2050	2030	2050
Wood and Waste	47	34	47	34	47	34
Renewable Distillate	181	26	15	0	32	18
Renewable Jet Fuel	-	114	-	-	-	56
Renewable Natural Gas	60	23	26	22	44	22
Hydrogen	27	148	3	69	17	88
Total	315	345	91	125	140	218

Table S2. Land use classes in New York State in 2022 and restricted classes from USDA-NASS land use data for suitable land assessment (1 is included, while 0 is restricted for willow cultivation)) [3,4].

Categories	Sub-classes	Pixels number (30m x 30m)	Area (ha)	Total (ha) (%)	Croplands scenario (CL)	No conventional croplands scenario (NCC)	No croplands scenario (NCL)
Barren	Barren	241502	21735	21,735 (0.2%)	1	1	1
Cultivated Crops land	Apples	177302	15957	813,327 (6.5%)	0	0	0
	Barley	7967	717		1	1	0
	Blueberries	2110	190		0	0	0
	Broccoli	2191	197		1	1	0
	Buckwheat ¹	2865	258		1	0	0
	Cabbage	30293	2726		1	1	0
	Cantaloupes	5	0		1	1	0
	Carrots	4523	407		1	1	0
	Cauliflower	72	6		1	1	0
	Cherries	1898	171		0	0	0
	Corn ²	5657593	509183		1	0	0
	Cucumbers	6595	594		1	1	0

	Dbl Crop Barley/Corn ²	171	15		1	0	0
	Dbl Crop Oats/Corn ²	37	3		1	0	0
	Dbl Crop Soybeans/Oats ³	90	8		1	0	0
	Dbl Crop Triticale/Corn ²	22322	2009		1	0	0
	Dbl Crop WinWht/Corn ²	1921	173		1	0	0
	Dbl Crop WinWht/Sorghum	320	29		1	1	0
	Dbl Crop WinWht/Soybeans ³	826	74		1	0	0
	Dry Beans	153974	13858		1	1	0
	Grapes	148563	13371		0	0	0
	Greens	546	49		1	1	0
	Hops	63	6		0	0	0
	Millet	1822	164		1	1	0
	Misc Veggies & Fruits	1838	165		1	1	0
	Oats	95817	8624		1	1	0
	Onions	41632	3747		1	1	0
	Other Crops	1883	169		1	1	0
	Other Small Grains	167	15		1	1	0
	Other Tree Crops	56	5		0	0	0
	Peaches	1858	167		0	0	0
	Pears	541	49		0	0	0
	Peas	34149	3073		1	1	0
	Peppers	571	51		1	1	0
	Plums	152	14		0	0	0
	Pop or Orn Corn ²	147	13		1	0	0
	Potatoes	59119	5321		1	1	0
	Pumpkins	7632	687		1	1	0
	Rye	45277	4075		1	1	0
	Sorghum	20702	1863		1	1	0
	Soybeans ³	1750747	157567		1	0	0
	Speltz	3246	292		1	1	0
	Spring Wheat ¹	5753	518		1	0	0
	Squash	11225	1010		1	1	0
	Strawberries	80	7		0	0	0
	Sugarbeets	12113	1090		1	1	0
	Sunflower	2684	242		1	1	0
	Sweet Corn ²	50780	4570		1	0	0
	Sweet Potatoes	18	2		1	1	0
	Tomatoes	55	5		1	1	0
	Triticale	24877	2239		1	1	0
	Walnuts	5	0		0	0	0
	Winter Wheat ¹	639772	57579		1	0	0

Developed area	Developed/High Intensity	1292152	116294	1,387,317 (11.0%)	0	0	0
	Developed/Low Intensity	4292623	386336		0	0	0
	Developed/Med Intensity	2748109	247330		0	0	0
	Developed/Open Space	7081746	637357		0	0	0
Forest	Deciduous Forest	55451769	4990659	7,174,389 (57.0%)	0	0	0
	Evergreen Forest	11627082	1046437		0	0	0
	Mixed Forest	12636582	1137292		0	0	0
Open water	Open Water	4334340	390091	390,091 (3.1%)	0	0	0
Herbaceous	Christmas Trees	14858	1337	767264 (6.1%)	0	0	0
	Clover/Wildflowers	54814	4933		1	1	1
	Fallow/Idle Cropland	121242	10912		1	1	1
	Herbs	405	36		1	1	1
	Sod/Grass Seed	17310	1558		1	1	1
	Alfalfa	3499140	314923		1	1	1
	Other Hay/Non Alfalfa	4817385	433565		1	1	1
Grassland/pasture	Grassland/Pasture	12405535	1116498	1,116,498 (8.9%)	1	1	1
Shrubland	Shrubland	226708	20404	20,404 (0.2%)	1	1	1
Wetlands	Herbaceous Wetlands	576458	51881	900,710 (7.2%)	0	0	0
	Woody Wetlands	9431431	848829		0	0	0

¹Conventional crop (Wheat); ²Conventional crop (Corn), ³Conventional crop (Soyabean)

Table S3. Potential biomass production (dry Mg) from the agricultural sector in NYS according to BT2023 [5,6]

Agricultural feedstocks	Near-term	Mature-market low	Mature-market medium	Mature-market high	Emerging and evolving
	Dry Mg of biomass				
Corn Stover	1,502,947	1,703,816	1,917,973	1,712,908	1,712,908
Oats straw	0	0	0	0	0
Wheat straw	25,673	21,155	20,866	56,920	56,920
Sorghum stubble	0	0	0	0	0
Miscanthus	0	546,259	750,435	1,759,117	1,759,117
Pennycress	0	211,964	211,964	211,964	211,964
Poplar	0	17,641	22,078	31,666	31,666
Switchgrass	0	0	0	0	0
Willow	0	1,023,874	1,094,120	1,533,059	1,533,059
Pruning residues, non-citrus	0	0	0	123,104	123,104

Pruning residues, tree nuts	0	0	0	97	97
Total	1,528,620	3,524,709	4,017,436	5,428,835	5,428,835

Table S4. Accuracy assessment of land characterization.

Class Value	Not Suitable	Suitable	Total	User Accuracy	Overall Accuracy	Kappa
Not Suitable	72	3	75	96%	99%	75%
Suitable	45	4582	4627	99%		
Total	117	4585	4702			
Produced Accuracy	62%	100%				

Table S5. SOC content at 0-30cm depth of soil in the identified potential in No Cropland (NCL) scenario in NYS.

SOC kg C/m ²	Land (ha)
≥ 0 ≤ 10	976,608
≥ 10 ≤ 20	84,239
≥ 20 ≤ 30	6,511
≥ 30 ≤ 40	3,494
≥ 40 ≤ 50	1,740
≥ 50 ≤ 60	437
≥ 60 ≤ 70	176
≥ 70 ≤ 96.6	14

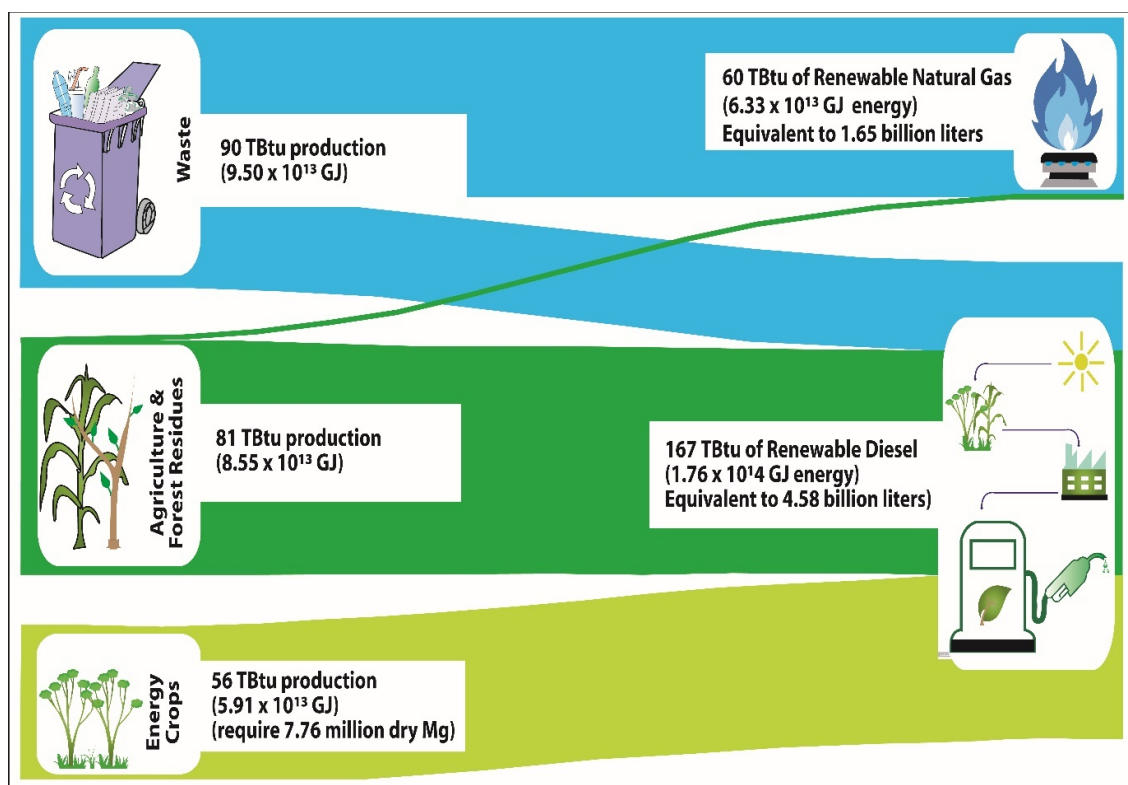


Figure S1. Low carbon fuel production targets by source of biomass in NYS scoping plan's Strategic Use of Low Carbon Fuels (SULCF) scenario for 2030 [1] (Conversion Factor: 38.47 MJ/Liter of renewable diesel, 212 liters of renewable diesel production per dry Mg [7] and purpose grown biomass yield 9.1 Mg per hectare per year [8]).

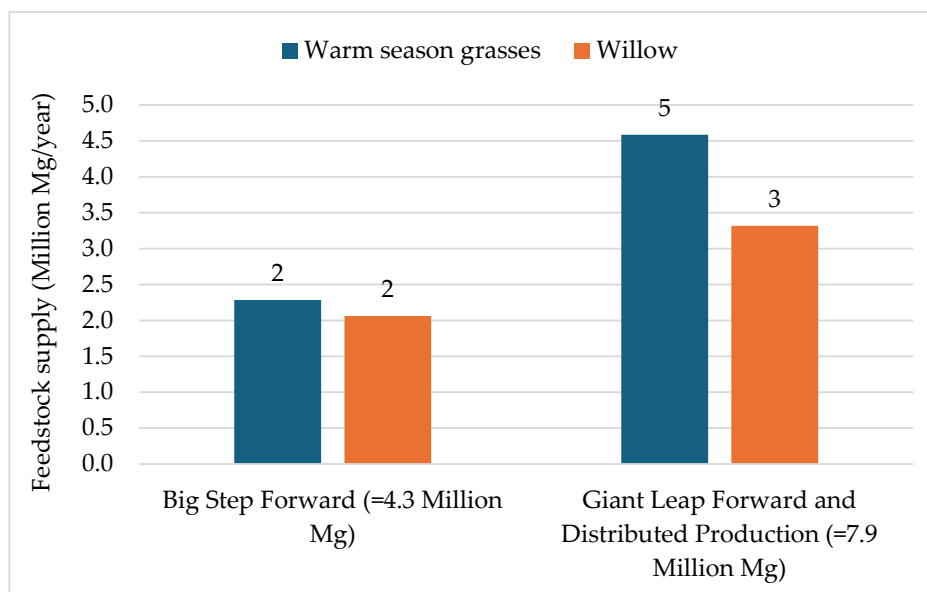


Figure S2. Estimated feedstocks supply for biofuels production for NYS in Renewable Fuels Roadmap [9].

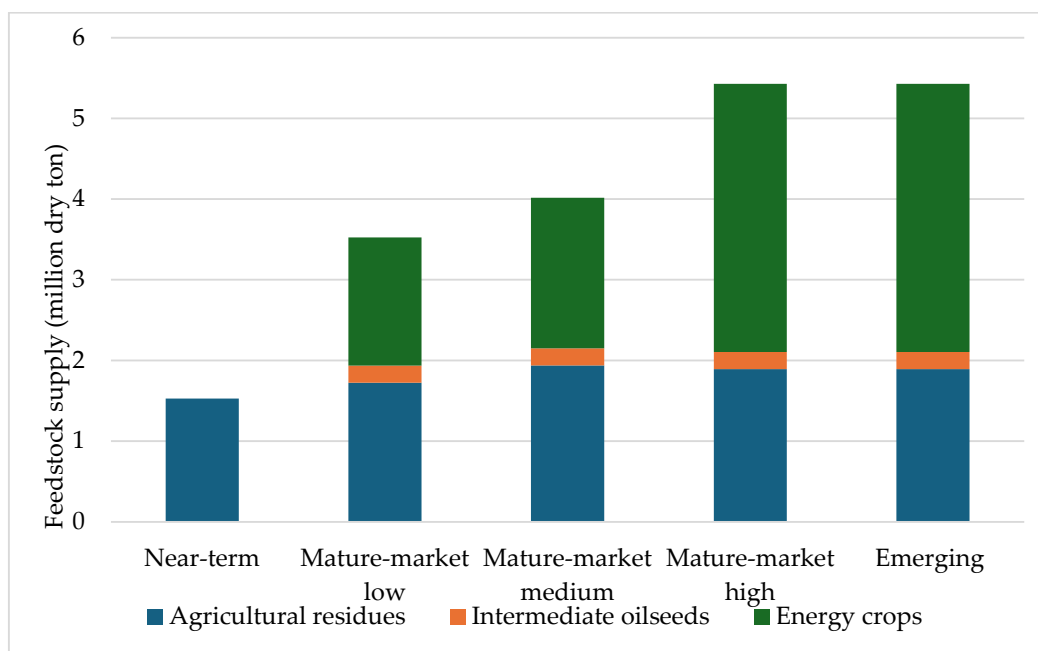


Figure S3. Potential Biomass Production from the Agricultural Sector in NYS According to BT2023 [5,6].

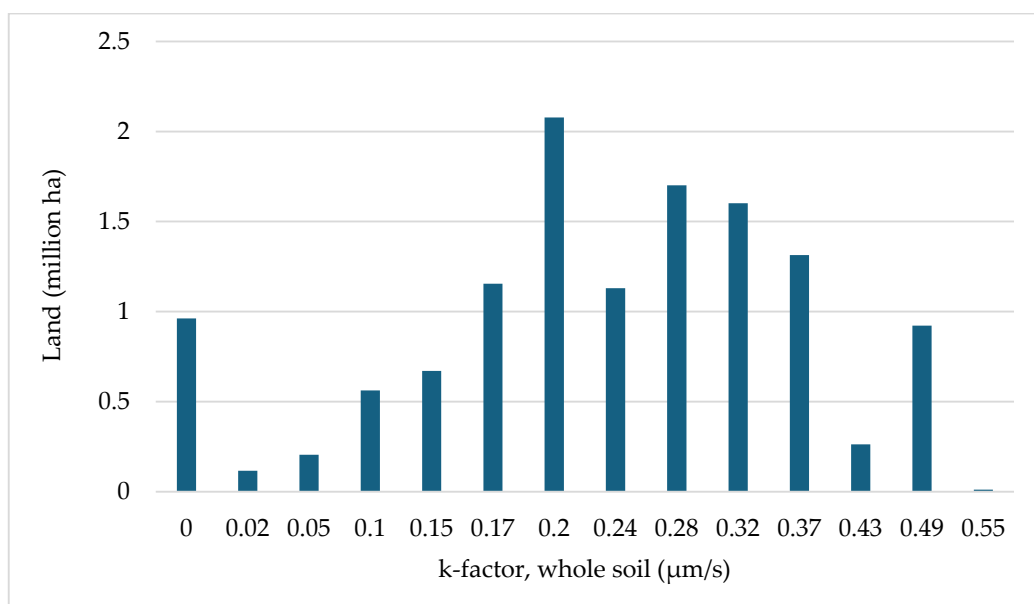


Figure S4. Distribution of soil erodibility factor, whole soil (K_w) in $\mu\text{m/s}$ in NYS.

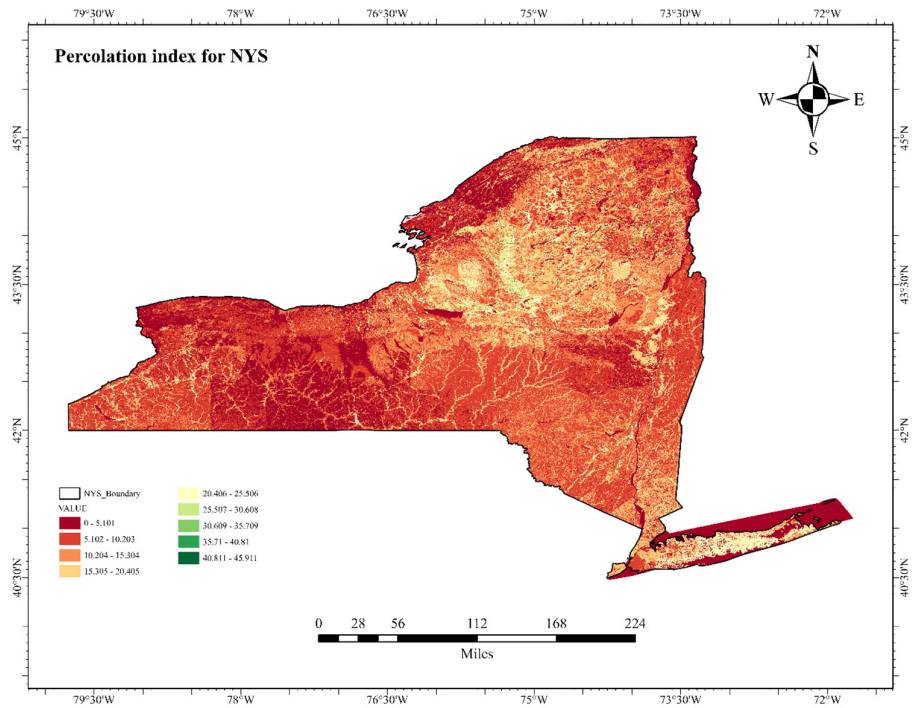


Figure S5. Percolation index in NYS.

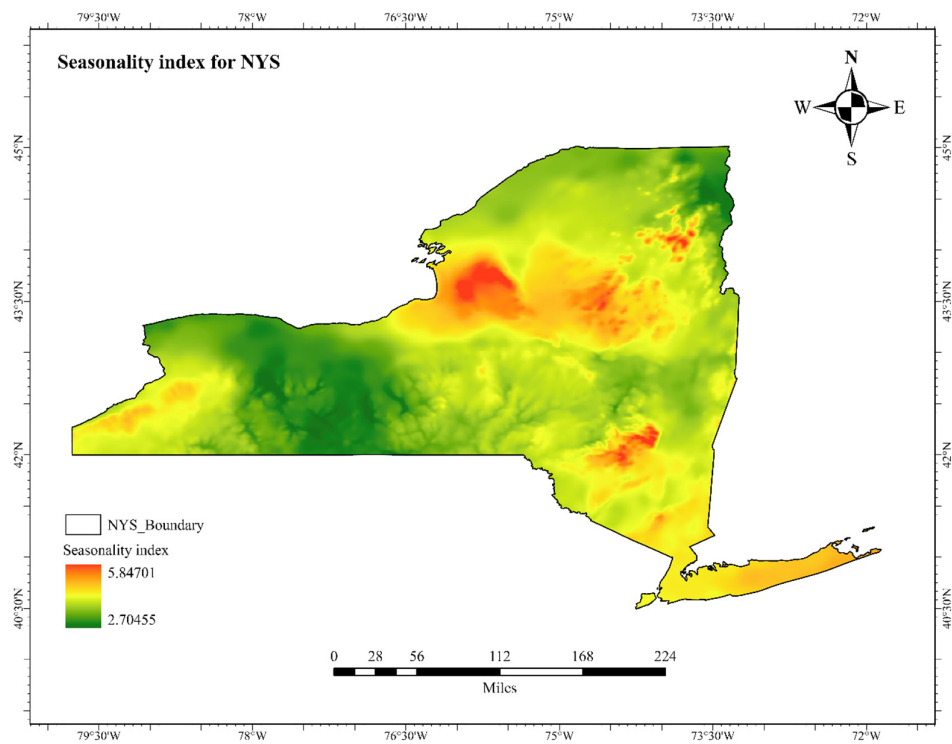


Figure S6. Seasonality index in NYS.

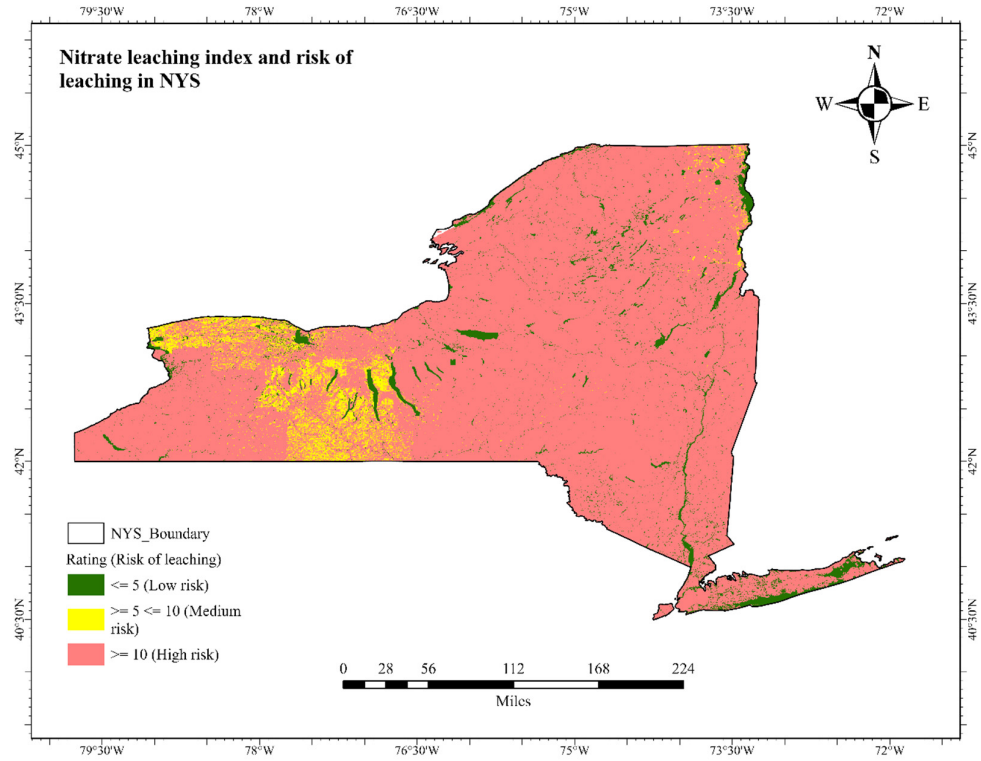


Figure S7. Nitrate leaching index in NYS.

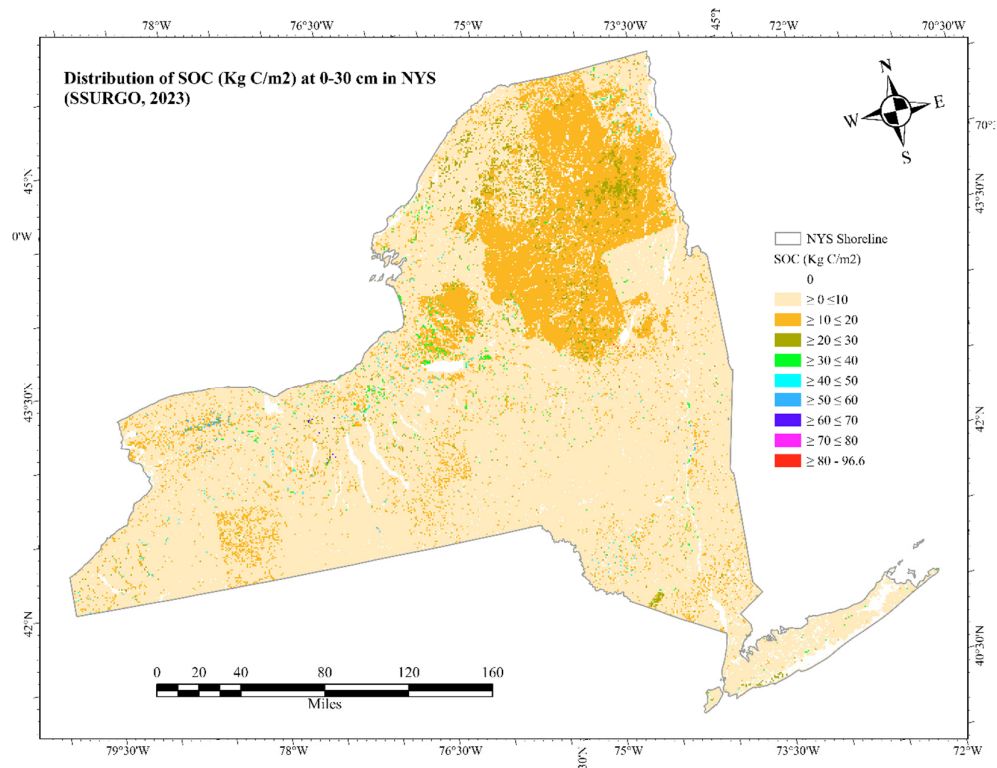


Figure S8. Distribution of SOC at 0-30cm depth of soil in NYS [10].

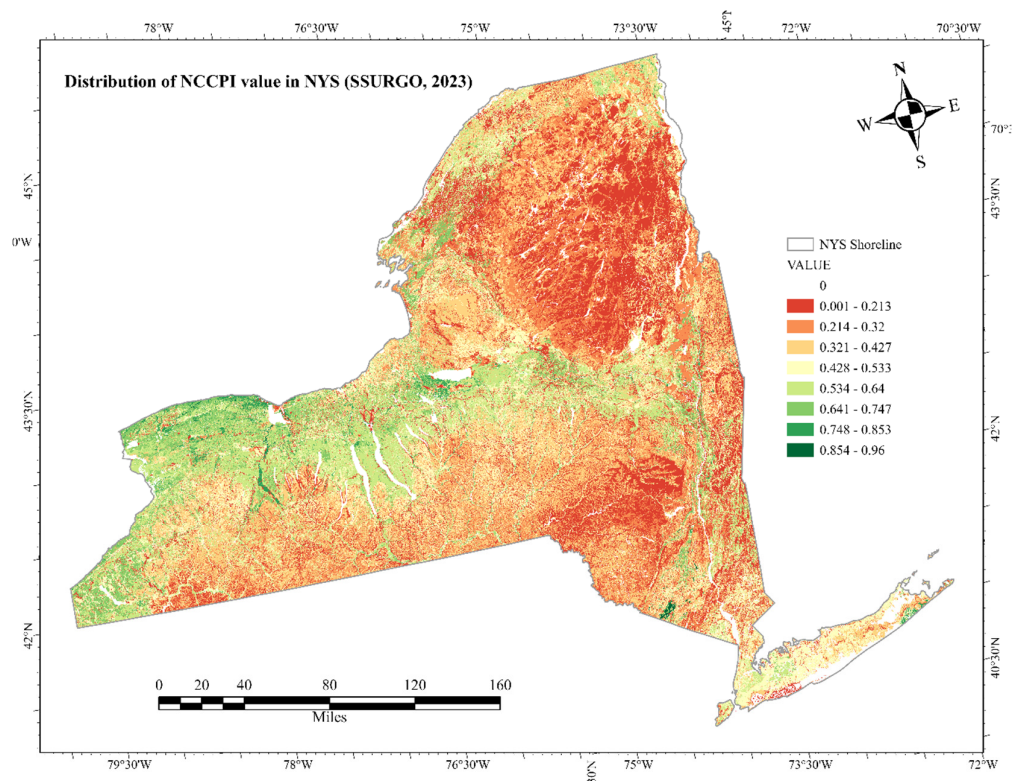


Figure S9. Distribution of National Commodity Crop Productivity Index (NCCPI) in the soil of NYS.

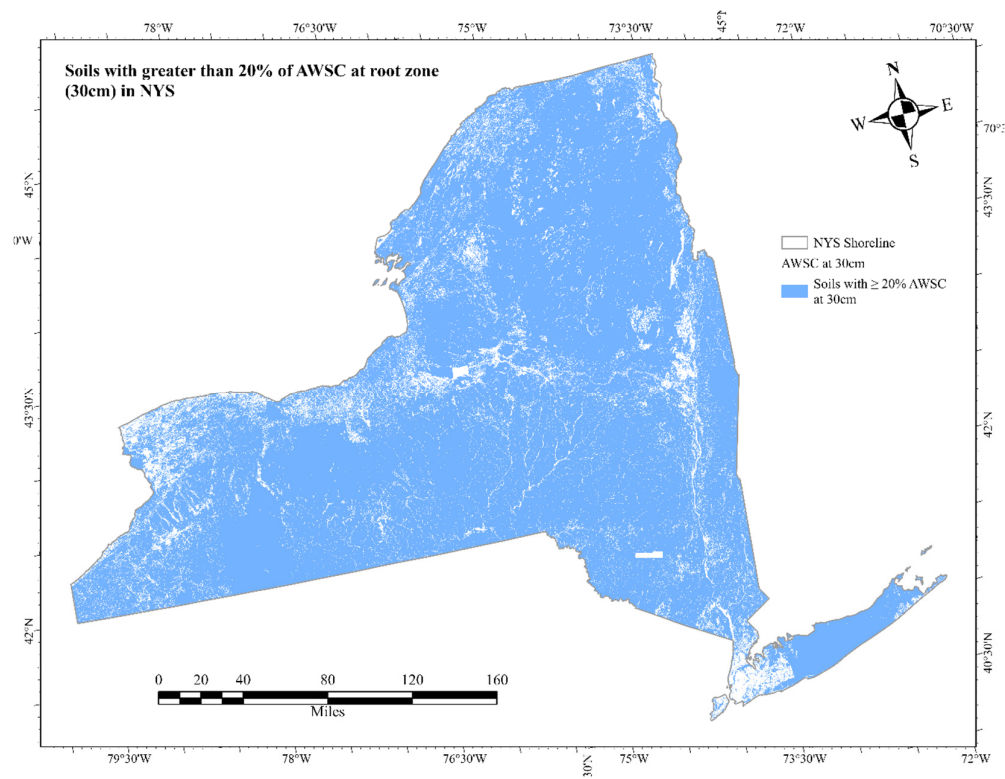


Figure S10. Soils with greater than 20% of Average Water Storage Capacity (AWSC) at plants' root zone (30 cm).

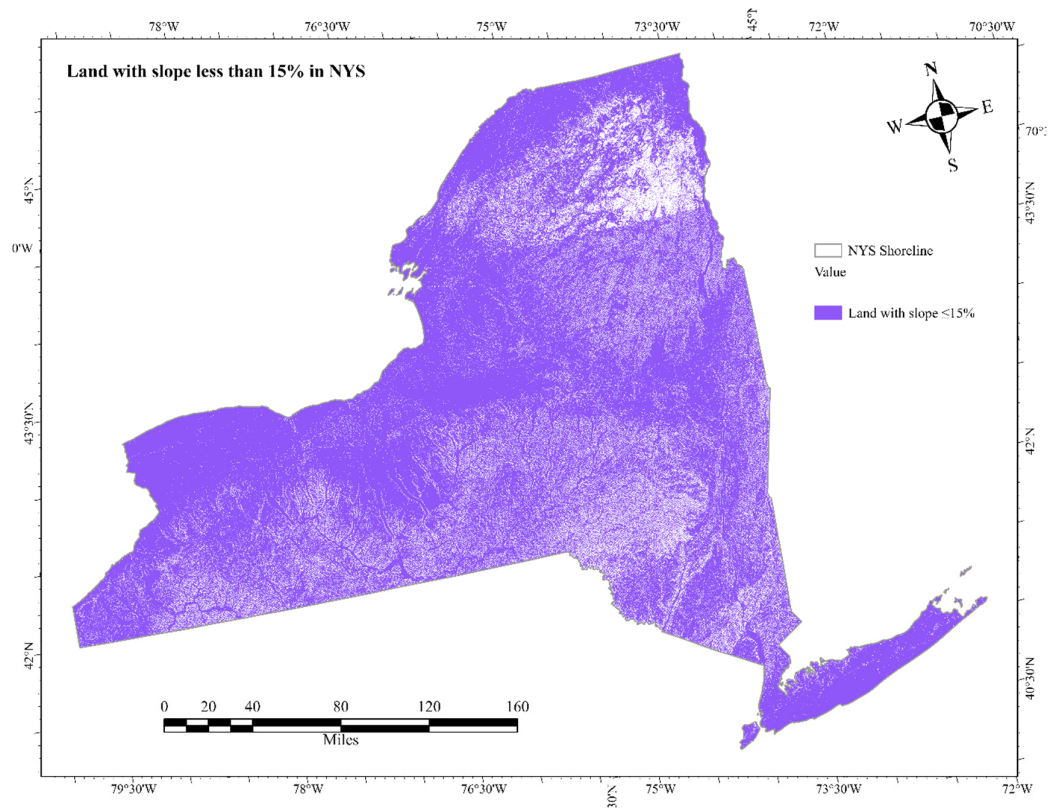


Figure S11. Land with slope less than 15% in NYS.

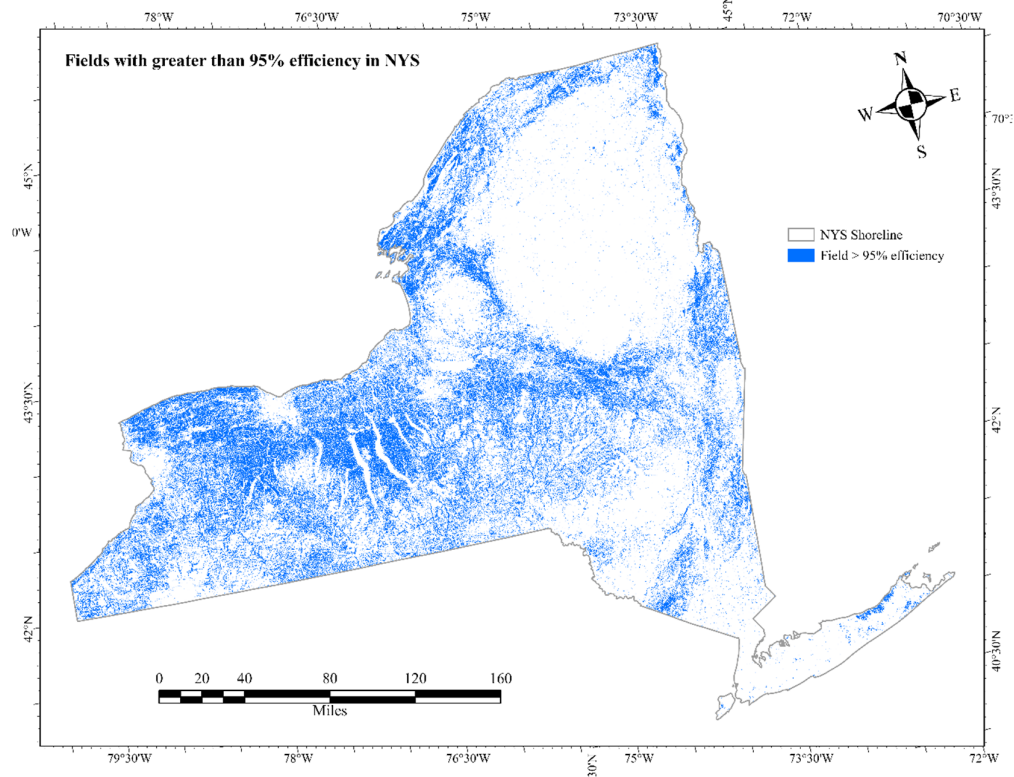


Figure S12. Fields with more than 95% harvesting efficiency.

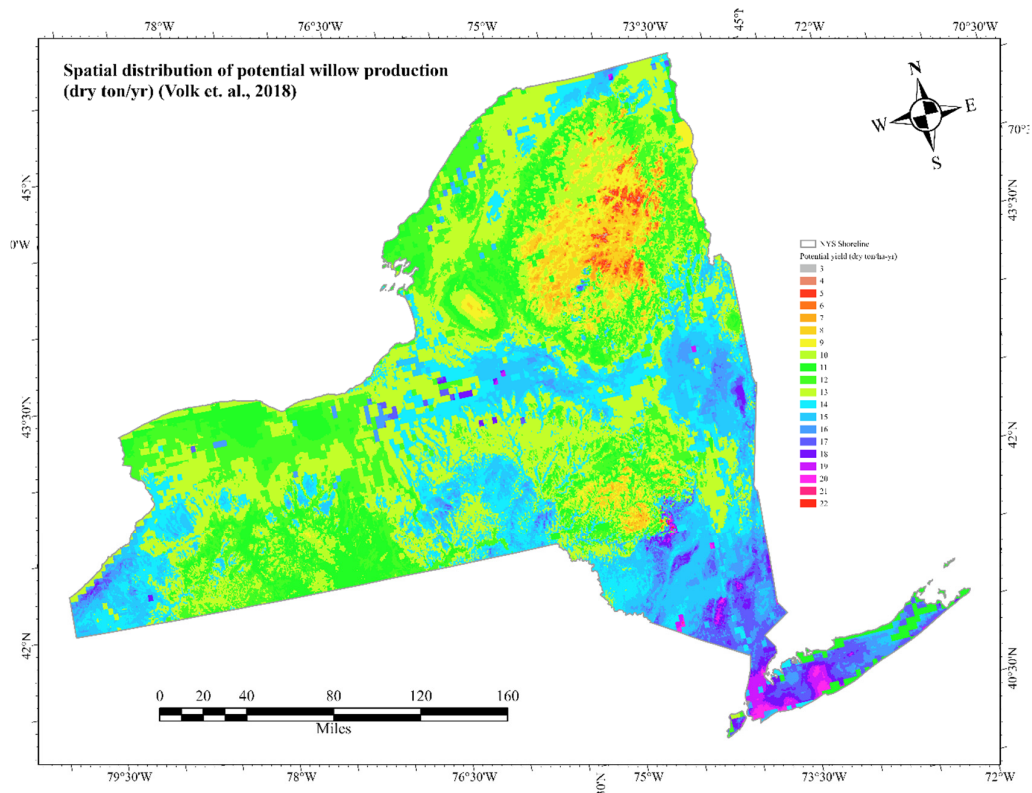


Figure S13. Potential willow production map (dry Mg/ha-yr) in PRISM-ELM model in NYS (derived from Daly et al. [11]).

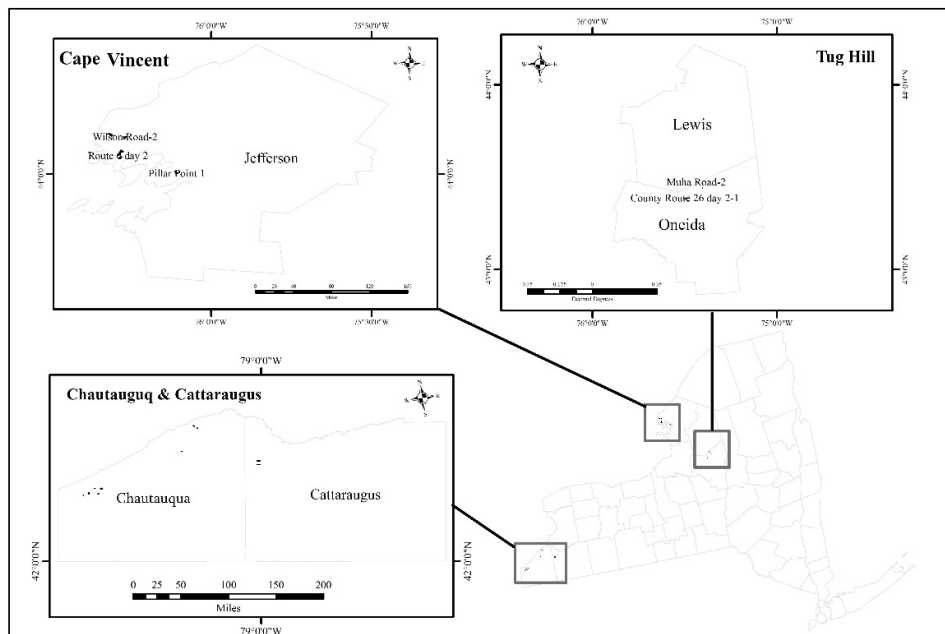


Figure S14. Geographical locations and name of willow field trails.

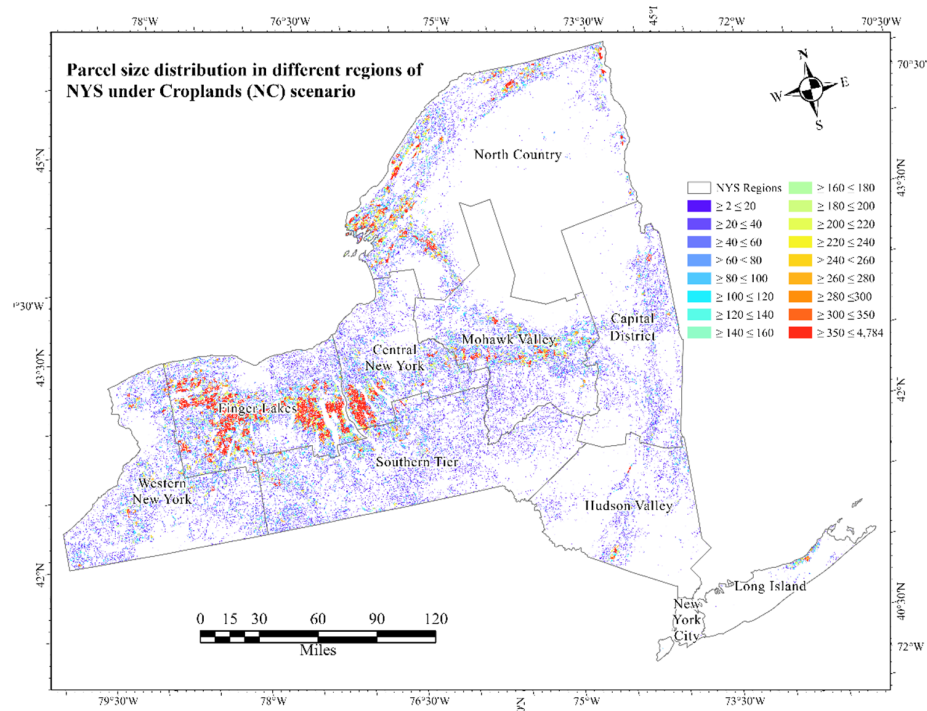


Figure S15. Distribution of parcel size identified in Croplands (CL) scenario in NYS.

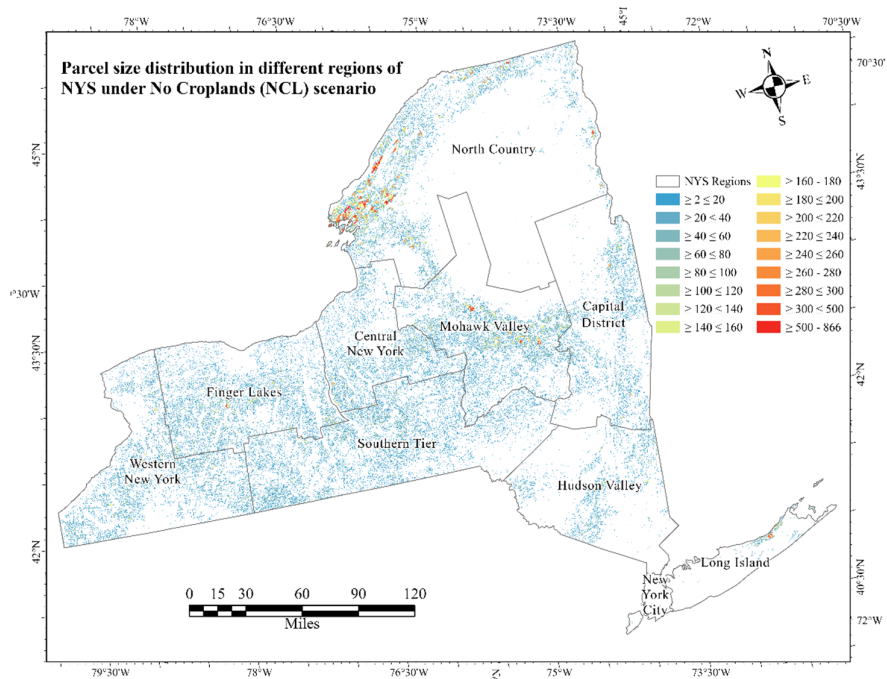


Figure S16. Distribution of parcel size identified in No Conventional Croplands (NCC) scenario in NYS.

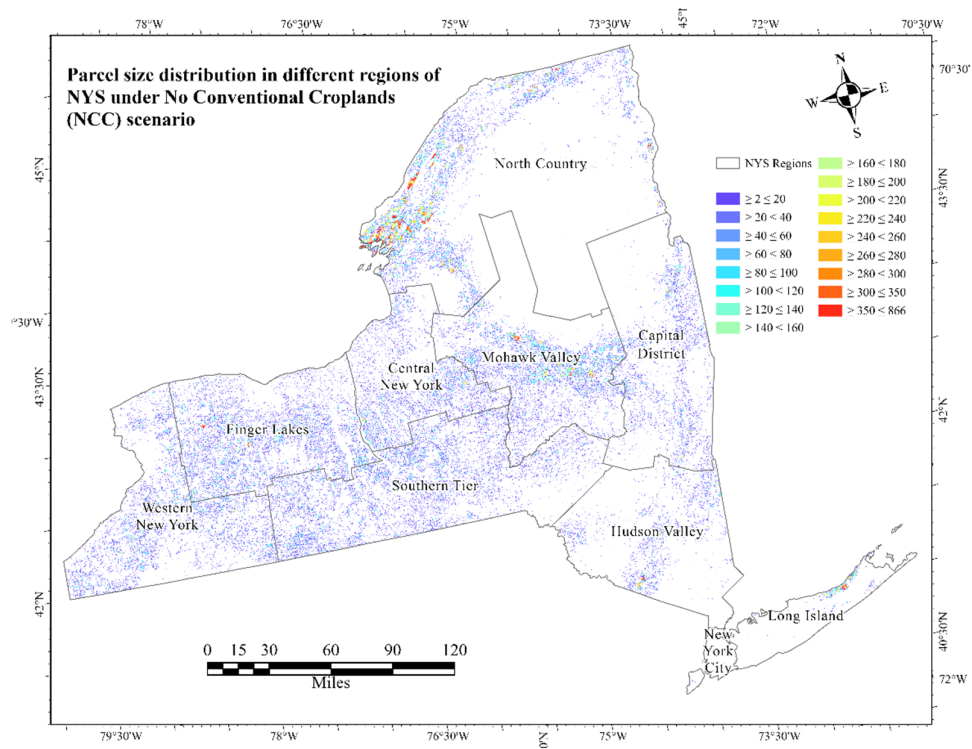


Figure S17. Distribution of parcel size identified in No Croplands (NCL) scenario in NYS.

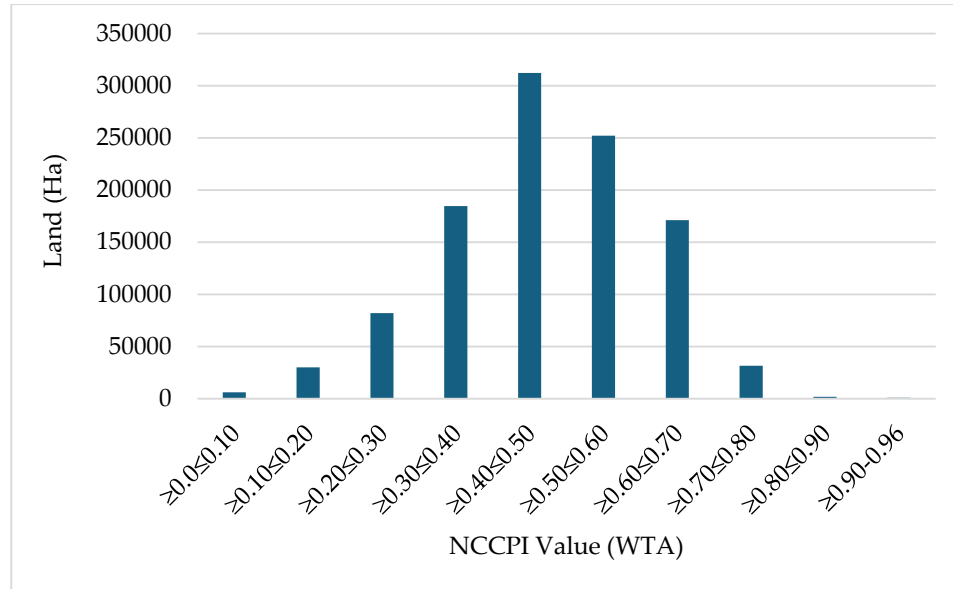


Figure S18. Distribution of NCCPI values in the identified potential land under the 'No Cropland (NCL)' scenarios.

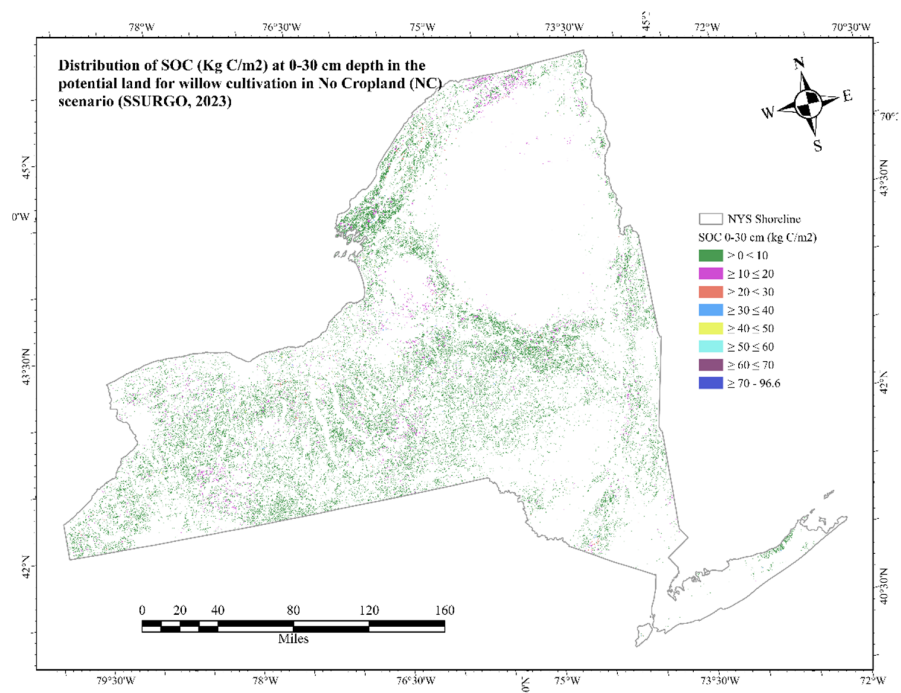


Figure S19. Distribution of SOC (kg/m²) at 0-30cm depth in the potential land identified in No Croplands (NCL) scenario in NYS.

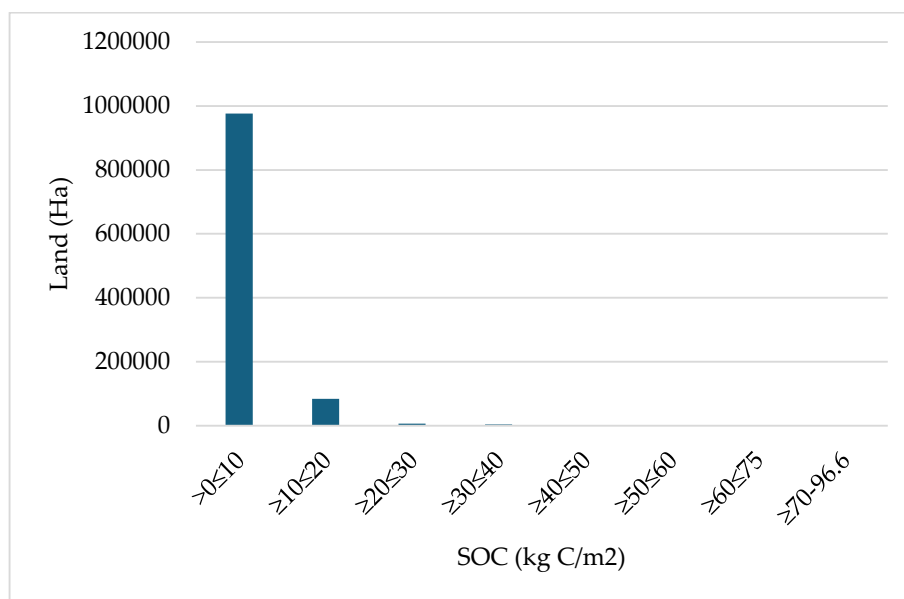


Figure S20. Distribution of SOC values in the identified potential land under the 'No Cropland (NCL)' scenarios.

References

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