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Conflicts of Interest and Emissions from Land Conversions: State of New Jersey as a Case Study

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Abstract: Conflicts of interest (COI) are an integral part of human society, including their influence on greenhouse gas (GHG) emissions and climate change. Individuals or entities often have multiple interests ranging from financial benefits to reducing climate change-related risks, where choosing one interest may negatively impact other interests and societal welfare. These types of COI require specific management strategies. This study examines COI from land-use decisions as an intersection of different perspectives on land use (e.g., land conservation versus land development), which can have various consequences regarding GHG emissions. This study uses the state of New Jersey (NJ) in the United States of America (USA) as a case study to demonstrate COI related to soil-based GHG emissions from land conversions between 2001 and 2016 which caused $722.2M (where M = million = 10^6) worth of "realized" social costs of carbon dioxide (SC-CO_2) emissions. These emissions are currently not accounted for in NJ's total carbon footprint (CF), which can negatively impact the state's ability to reach its carbon reduction goals. The state of NJ Statutes Annotated 26:2C-37 (2007): Global Warming Response Act (GWRA) (updated in 2019) set a statewide goal of reducing GHG emissions to 80 percent below 2006 levels by 2050. Remote sensing and soil data analysis allow temporal and quantitative assessment of the contribution of land cover conversions to NJ's CF by soil carbon type, soil type, land cover type, and administrative units (state, counties), which helps document past, and estimate future related GHG emissions using a land cover change scenario to calculate the amount of GHG emissions if an area of land was to be developed. Decisions related to future land conversions involve potential COI within and outside state administrative structures, which could be managed by a conflict-of-interest policy. The site and time-specific disclosures of GHG emissions from land conversions can help governments manage these COI to mitigate climate change impacts and costs by assigning financial responsibility for specific CF contributions. Projected sea-level rise will impact 16 out of 21 NJ's counties and it will likely reach coastal areas with densely populated urban areas throughout NJ. Low proportion of available public land limits opportunities for relocation. Increased climate-change-related damages in NJ and elsewhere will increase the number of climate litigation cases to alleviate costs associated with climate change. This litigation will further highlight the importance and intensity of different COI.

Keywords: carbon; CO_2; climate change; conflict-of-interest policy; damage; ecosystem; services

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1. Introduction

Conflicts of interest with regard to land and its use often represent conflicting perspectives (e.g., conservation versus development), which is one of the driving forces in climate change and GHG emissions (Figure 1). The land conservation perspective recognizes the long-term climate change benefits of soil carbon (C) sequestration in undisturbed land, which results in "avoided" social costs of C (SC-CO_2) [1]. The land development perspective is focused on economic benefits (e.g., taxes, revenue) because of land conversions from "low disturbance" land use/land cover (LULC) classes (e.g., forest, pasture) to "developed" LULC classes, which result in "realized" SC-CO_2 [1]. Conflicts of interest are important in these land-use decisions but often are not considered within the decision-making process. Identifying COI within the decision-making process could help minimize GHG emissions by identifying the monetary value of SC-CO_2 associated with different land conversion scenarios.

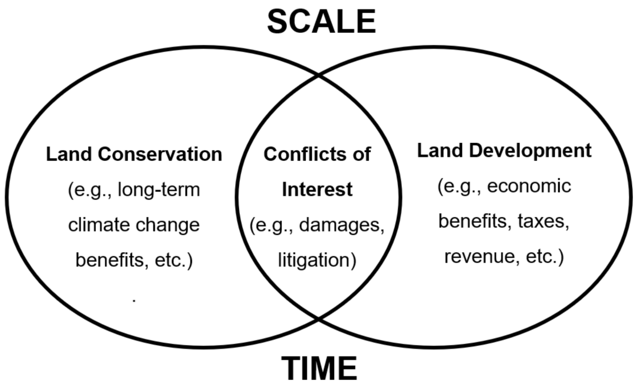

Figure 1. Conflicts of interest can be viewed as an intersection of different perspectives on land use.

The Role of Soils in New Jersey Global Warming Response Act

On 6 July 2007, the State of NJ passed the Global Warming Response Act ("GWRA"), N.J.S.A. 26:2C-37 [2], and updated it in 2019, creating a statewide goal of reducing GHG emissions to 80 percent below 2006 levels by 2050 [3]. New Jersey is part of only a handful of states with specific GHG reduction goals [4], which support the goals of the Paris Agreement [5] and the United Nations Sustainable Development Goals (SDGs) [6]. Total 2018 GHG emissions for New Jersey were approximately 105.1 million metric tons (MMT) of carbon dioxide equivalent (CO_2 e), which is meant to represent the emission Global Warming Potential compared to CO_2 as a reference gas with a potential impact on global warming of one [7]. The state estimated that its forests and similar land cover were able to sequester approximately 8.1 MMTCO_2 e which serves as an 8% sink when compared to the GHG releases, thereby reducing the total GHG 2018 emissions to 97.0 MMTCO_2 e [8]. New Jersey's 2018 GHG emission inventory identifies the following sources of GHG emissions: transportation (42%), electricity generation (19%), commercial and industrial (17%), residential (16%), highly warming gases (8%), waste management (5%), land clearing (1%) [8]. There are few details about the land clearing category in the report, which does not mention GHG emissions related to soil disturbances.

Pedodiversity (soil composition) of NJ controls the potential of regulating ecosystem services/disservices (ES/ED), which is the soil's potential to release or store CO_2 (Table 1, Figure 2) [9]. There are six soil orders in the state of NJ, belonging to slightly weathered (Entisols, Inceptisols, Histosols), moderately weathered (Alfisols), and strongly weathered (Spodosols, Ultisols) soils with different soil C storages and climate change vulnerabilities. The state of NJ has chosen Downer as the State Soil (soil order: Ultisols) because of its provisioning ES value (e.g., woodland, high-value fruit, and vegetable crops) [10].

Table 1. Soil diversity (pedodiversity) is represented by taxonomic diversity at the soil order level with ecosystem service types in New Jersey (USA) [11].

Stocks		Ecosystem Services		
Soil Order	**General Characteristics and Constraints**	**Provisioning**	**Regulation/ Maintenance**	**Cultural**
	Slightly Weathered			
Entisols	Embryonic soils with an ochric epipedon	x	x	x
Inceptisols	Young soils with an ochric or umbric epipedon	x	x	x
Histosols	Organic soils with ≥20% organic carbon	x	x	x
	Moderately Weathered			
Alfisols	Clay-enriched B horizon with B.S. ≥35%	x	x	x
	Strongly Weathered			
Spodosols	Coarse-textured soils with albic and spodic horizons	x	x	x
Ultisols	Highly leached soils with B.S. <35%	x	x	x

Note: B.S. = base saturation.

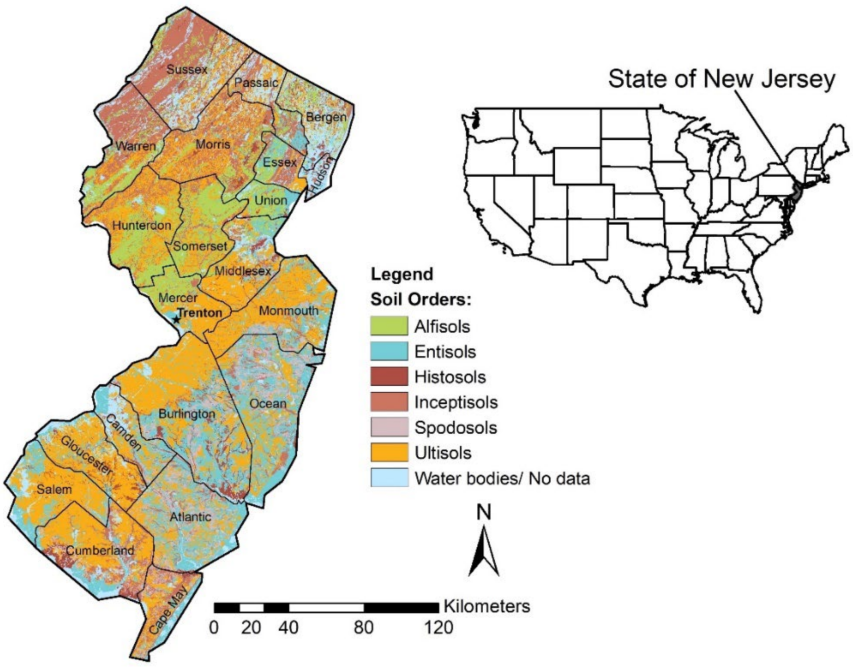

Figure 2. General soil map of New Jersey (USA) (Latitude: 38° 56′ N to 41° 21′ N; Longitude: 73° 54′ W to 75° 34′ W) from the SSURGO database [12] with county boundaries overlaid [13].

Soils of NJ supply countless ES/ED, which makes them a valuable resource that is largely privately owned (81.7%) [14]. New Jersey experienced an increase in urban sprawl-type development from 1986 to 1995, which was documented by a detailed remote sensing analysis [15]. According to this analysis, the newly developed areas in the nine-year period were equal to the total land area of Essex and Union counties combined [15]. At this development rate, NJ will likely be the first state in the country to be completely built out [15].

Soils have the largest terrestrial storage of C, which makes them a significant source and sink of atmospheric CO_2 [16]. Land use and land cover change (LULCC) is the second largest source of CO_2 emissions into the atmosphere after fossil fuel combustion emissions [16]. Most of the previous research on soil C focused on emissions from agricultural activities with a significant research gap on C loss from land conversions to developments [17]. Soil C has high societal value because it provides various provisioning, regulation, and cultural services [18]. It can also be lost to the atmosphere because of various COIs [19].

The present study hypothesizes that there are inherent COI related to land use (conservation versus development) that need to be disclosed by quantifying potential GHG emissions from land conversions to complement existing infrastructure cost estimates and future tax revenue benefits commonly available to support local pre-development decision-making. Our study will use newly determined soil-based emission estimates from prior land conversions in NJ obtained through integrated remote sensing and soil spatial data analysis to quantify past GHG emissions. Our study will demonstrate how spatially explicit scientific data on GHG emissions can be converted into monetary valuations that represent the social costs of carbon dioxide (SC-CO_2) emissions for different development scenarios which can be used by local and state governments to help guide pre-development decisions.

This study's objective was to determine the value of soil inorganic carbon (SIC), soil organic carbon (SOC), and total soil carbon (TSC) for the state of NJ (USA) and evaluate its change over 15 years based on the avoided emissions provided by C sequestration and the social cost of C (SC-CO_2), which is assumed to be \$46 per metric ton of CO_2 (applicable for the year 2025 based on 2007 U.S. dollars using an average discount rate of 3% by the U.S. Environmental Protection Agency (EPA)) [1]. This study provides monetary value estimates of SOC, SIC, and TSC both throughout the state of NJ and by various aggregation levels (i.e., county) by employing the State Soil Geographic (STATSGO) and Soil Survey Geographic Database (SSURGO) databases and earlier information developed by Guo et al. (2006) [20]. Classified land cover data for 2001 and 2016 were obtained from the Multi-Resolution Land Characteristics Consortium (MRLC) website [21].

2. Materials and Methods

This research employed biophysical and administrative (Figure 2) accounting to estimate the social cost monetary values of SOC, SIC, and TSC (Tables 2 and 3). This accounting framework helps elucidate potential COI and corresponding social costs related to soil-based GHG emissions.

Table 2. An overview of the accounting framework (including conflicts of interest, COI) used by this research (adapted from Groshans et al. (2019) [22]).

Ownership (e.g., government, private, foreign, shared, single, etc.)					
	Stocks/Source Attribution		**Flows**		**Value**
Time (e.g., information disclosure, etc.)	**Biophysical Accounts (Science-Based)**	**Administrative Accounts (Boundary-Based)**	**Monetary Account(s)**	**Benefit(s)/ Damages**	**Total Value**
	Soil extent:	Administrative extent:	Ecosystem good(s) and service(s):	Sector:	Types of value:
	Composite (total) stock: Total soil carbon (TSC) = Soil organic carbon (SOC) + Soil inorganic carbon (SIC)				
Past (e.g., post-development disclosures) **Current** (e.g., status) **Future** (e.g., pre-development disclosures)	- Soil orders (Entisols, Inceptisols, Histosols, Alfisols, Spodosols, Ultisols).	- State (New Jersey); - County (21 counties).	- Regulation (e.g., carbon sequestration); - Provisioning (e.g., food production).	Environment: - Carbon gain (sequestration); - Carbon loss.	"Avoided" or "realized" social cost of carbon (SC-CO_2) emissions: - \$46 per metric ton of CO_2 applicable for the year 2025 (2007 U.S. dollars with an average discount rate of 3% [1]).
			Conflicts of Interest (COI)		

Table 3. Soil diversity by soil order and county for the State of New Jersey (USA) from the Soil Survey Geographic (SSURGO) Spatial Database [12].

County	Total Soil Area (km^2) (%)	Degree of Weathering and Soil Development					
		Slight			Moderate	Strong	
		Entisols	Inceptisols	Histosols	Alfisols	Spodosols	Ultisols
		2016 Area (km^2), (% of Total County Area)					
Atlantic	1395.3 (8)	627.5 (45)	106.1 (8)	0.1 (0)	0 (0)	316.5 (23)	345.2 (25)
Bergen	350.2 (2)	50.6 (14)	47.9 (14)	65.7 (19)	97.6 (28)	0 (0)	88.4 (25)
Burlington	2013.2 (12)	650.6 (32)	42.2 (2)	159.2 (8)	0 (0)	168.7 (8)	992.5 (49)
Camden	457.6 (3)	184.6 (40)	47.3 (10)	5.9 (1)	0 (0)	54.2 (12)	165.7 (36)
Cape May	603.9 (3)	124.7 (21)	181.7 (30)	22.7 (4)	0 (0)	100.1 (17)	174.7 (29)
Cumberland	1184.1 (7)	152.2 (13)	207.8 (18)	84.3 (7)	0 (0)	102.2 (9)	637.7 (54)
Essex	296.8 (2)	67.0 (23)	102.6 (35)	2.6 (1)	70.0 (24)	0 (0)	54.7 (18)
Gloucester	742.6 (4)	99.5 (13)	20.1 (3)	71.8 (10)	0 (0)	4.3 (1)	546.9 (74)
Hudson	41.1 (0.1)	14.1 (34)	19.2 (47)	7.3 (18)	0.5 (1)	0 (0)	0 (0)
Hunterdon	1103.9 (6)	14.6 (1)	223.7 (20)	0 (0)	397.6 (36)	0 (0)	468.0 (42)
Mercer	557.2 (3)	55.1 (10)	35.2 (6)	0 (0)	193.4 (35)	0 (0)	273.3 (49)
Middlesex	718.0 (4)	124.0 (17)	62.5 (9)	50.4 (7)	84.7 (12)	35.6 (5)	360.6 (50)
Monmouth	1172.3 (7)	282.4 (24)	107.8 (9)	0.7 (0)	0 (0)	65.7 (6)	715.8 (61)
Morris	1124.4 (6)	34.5 (3)	455.6 (41)	51.9 (5)	140.0 (12)	0 (0)	442.3 (39)
Ocean	1577.9 (9)	773.7 (49)	165.9 (11)	10.5 (1)	0 (0)	294.2 (19)	333.7 (21)
Passaic	358.3 (2)	56.2 (16)	149.6 (42)	12.7 (4)	32.4 (9)	0 (0)	107.3 (30)
Salem	795.3 (5)	209.7 (26)	0.3 (0)	18.3 (2)	0 (0)	24.2 (3)	542.8 (68)
Somerset	776.7 (4)	10.2 (1)	127.2 (16)	0 (0)	420.2 (54)	0 (0)	219.1 (28)
Sussex	1050.0 (6)	37.4 (4)	716.1 (68)	39.3 (4)	134.4 (13)	0 (0)	122.8 (12)
Union	244.6 (1)	72.8 (30)	10.1 (4)	4.2 (2)	141.1 (58)	0 (0)	16.4 (7)
Warren	811.4 (5)	24.5 (3)	473.7 (58)	11.0 (1)	199.2 (25)	316.5 (0)	103.0 (13)
Totals	**17,374.8 (100)**	**3665.8 (21)**	**3302.6 (19)**	**618.6 (3)**	**1911.2 (11)**	**1165.6 (7)**	**6711.1 (39)**

This study calculates monetary values from the soil stocks of SOC, SIC, and TSC in NJ using published soil C contents (kg m^{-2}) from Guo et al. (2006) [20]. These values were estimated based on the avoided social cost of carbon (SC-CO_2) at \$46 per metric ton of CO_2 (applicable for 2025 using 2007 U.S. dollars and an average discount rate of 3%) [1]. According to the U.S. EPA, the SC-CO_2 is meant to represent a full estimate of climate change damage. It likely underestimates actual damages from CO_2 emissions by excluding various impacts from climate change [1]. Area-normalized values (\$ m^{-2}) were calculated with Equation (1), and the monetary values were totaled over the relevant area(s) (one metric tonne is equal to 1 megagram (Mg) or 1000 kilograms (kg), and SC = soil carbon, e.g., SOC, SIC, or TSC):

$$\frac{\$}{\mathrm{m}^2} = \left(\mathrm{SOC/SIC/TSC\ Content}, \frac{\mathrm{kg}}{\mathrm{m}^2}\right) \times \frac{1\ \mathrm{Mg}}{10^3\ \mathrm{kg}} \times \frac{44\ \mathrm{Mg\ CO_2}}{12\ \mathrm{Mg\ SC}} \times \frac{\$46}{\mathrm{Mg\ CO_2}} \quad (1)$$

Table 4 shows area-normalized amounts (kg m^{-2}) and soil carbon monetary values (\$ m^{-2}), which were utilized to estimate stocks of SOC, SIC, and TSC and their corresponding monetary values by multiplying the soil contents/values of a county by the area of a particular soil order within that county (Table 3). As an example, for the soil order of Inceptisols, Guo et al. (2006) [20] reported a midpoint SOC content in the upper 2-m depth of soil as 8.9 kg m^{-2} (Table 4). Using this content of SOC in equation (1) results in an area-normalized SOC monetary value of \$1.50 m^{-2} for Inceptisols. Multiplying the SOC content and its relevant area-normalized value by the total area of Inceptisols in NJ (3302.6 km^2, Table 3) results in an estimated SOC stock of 2.9×10^{10} kg and a monetary value of \$5.0B, respectively.

Table 4. Area-normalized content (kg m^{-2}) and monetary values ($ m^{-2}) of soil organic carbon (SOC), soil inorganic carbon (SIC), and total soil carbon (TSC = SOC + SIC) by soil order using data developed by Guo et al. (2006) [20] for the upper 2-m of soil and an avoided social cost of carbon (SC-CO_2) of $46 per metric ton of CO_2, applicable for 2025 (2007 U.S. dollars with an average discount rate of 3% [1]).

Soil Order	SOC Content	SIC Content	TSC Content	SOC Value	SIC Value	TSC Value
	Minimum—Midpoint—Maximum Values			Midpoint Values		
	(kg m^{-2})	(kg m^{-2})	(kg m^{-2})	($ m^{-2})	($ m^{-2})	($ m^{-2})
Slightly Weathered						
Entisols	1.8–8.0–15.8	1.9–4.8–8.4	3.7–12.8–24.2	1.35	0.82	2.17
Inceptisols	2.8–8.9–17.4	2.5–5.1–8.4	5.3–14.0–25.8	1.50	0.86	2.36
Histosols	63.9–140.1–243.9	0.6–2.4–5.0	64.5–142.5–248.9	23.62	0.41	24.03
Moderately Weathered						
Alfisols	2.3–7.5–14.1	1.3–4.3–8.1	3.6–11.8–22.2	1.27	0.72	1.99
Strongly Weathered						
Spodosols	2.9–12.3–25.5	0.2–0.6–1.1	3.1–12.9–26.6	2.07	0.10	2.17
Ultisols	1.9–7.1–13.9	0.0–0.0–0.0	1.9–7.1–13.9	1.20	0.00	1.20

New Jersey land use/land cover change between 2001 and 2016 was evaluated using classified Multi-Resolution Land Characteristics Consortium (MRLC) land cover data with an overall 91% accuracy [21]. Land cover changes, by soil type, were analyzed in ArcGIS Pro 2.6 [23] through a comparison of the 2001 and 2016 land cover data, by converting the MRLC land cover layers from raster to vector format, and then by using the union function within the ArcGIS Pro toolbox to combine the land cover data with the Soil Survey Geographic (SSURGO) soils layers [12]. Information from the unioned data land cover and soils data layers were extracted into tables using Python scripts.

3. Soil Carbon Regulating Ecosystem Services and Land Cover Change in the State of New Jersey

The total estimated monetary mid-point SC-CO_2 value for TSC in the state of NJ was $45.0B (i.e., 45.0 billion U.S. dollars, where B = billion = 10^9), $37.4B for SOC (83% of the total value), and $7.6B for SIC (17% of the total value). Previously, we have reported that among the 48 conterminous states of the U.S., NJ ranked 45th for TSC [9], 45th for SOC [24], and 44th for SIC [22].

3.1. Value of SOC by Soil Order and County for New Jersey

Soil orders with the highest midpoint monetary value for SOC were Histosols ($15.0B), Ultisols ($8.1B), and Inceptisols ($5.0B) (Tables 5 and S1). Histosols contributed 39% of SOC, followed by Ultisols (22%), and Inceptisols (13%). The counties showing the highest midpoint SOC values were Burlington ($6.2B), Cumberland ($3.5B), and Morris ($2.7B) (Tables 5 and S1). Burlington contributed 17% of the total state's SOC, followed by Cumberland (9%), and Morris (7%). Burlington is the largest county in the state with large areas of Ultisols, Entisols, and Histosols (Table 3).

3.2. Value of SIC by Soil Order and County for New Jersey

Soil orders with the highest SIC midpoint monetary value were Entisols ($3.0B), Inceptisols ($2.8B), and Alfisols ($1.4B) (Table S2 and Table 6). Entisols contributed 40% of SIC, followed by Inceptisols (37%), and Alfisols (18%). The counties with the highest midpoint SIC values were Ocean ($810.8M), Sussex ($759.3M), and Burlington ($651.9M) (Tables 6 and S2).

Table 5. Midpoint monetary values of soil organic carbon (SOC) by soil order and county for the state of New Jersey (USA), based on the areas shown in Table 3 and the area-normalized midpoint monetary values in Table 4.

County	Total $SC\text{-}CO_2$ ($ = USD)	Degree of Weathering and Soil Development					
		Slight			Moderate	Strong	
		Entisols	Inceptisols	Histosols	Alfisols	Spodosols	Ultisols
		Soil Organic Carbon (SOC), $SC\text{-}CO_2$ ($ = USD)					
Atlantic	2.1×10^9	8.5×10^8	1.6×10^8	1.6×10^6	0	6.6×10^8	4.1×10^8
Bergen	1.9×10^9	6.8×10^7	7.2×10^7	1.6×10^9	1.2×10^8	0	1.1×10^8
Burlington	6.2×10^9	8.8×10^8	6.3×10^7	3.8×10^9	6.1×10^4	3.5×10^8	1.2×10^9
Camden	7.7×10^8	2.5×10^8	7.1×10^7	1.4×10^8	0	1.1×10^8	2.0×10^8
Cape May	1.4×10^9	1.7×10^8	2.7×10^8	5.4×10^8	0	2.1×10^8	2.1×10^8
Cumberland	3.5×10^9	2.1×10^8	3.1×10^8	2.0×10^9	0	2.1×10^8	7.7×10^8
Essex	4.6×10^8	9.0×10^7	1.5×10^8	6.1×10^7	8.9×10^7	0	6.6×10^7
Gloucester	2.5×10^9	1.3×10^8	3.0×10^7	1.7×10^9	0	8.8×10^6	6.6×10^8
Hudson	2.2×10^8	1.9×10^7	2.9×10^7	1.7×10^8	6.9×10^5	0	0
Hunterdon	1.4×10^9	2.0×10^7	3.4×10^8	0	5.0×10^8	0	5.6×10^8
Mercer	7.0×10^8	7.4×10^7	5.3×10^7	1.1×10^6	2.5×10^8	1.2×10^1	3.3×10^8
Middlesex	2.1×10^9	1.7×10^8	9.4×10^7	1.2×10^9	1.1×10^8	7.4×10^7	4.3×10^8
Monmouth	1.6×10^9	3.8×10^8	1.6×10^8	1.6×10^7	0	1.4×10^8	8.6×10^8
Morris	2.7×10^9	4.7×10^7	6.8×10^8	1.2×10^9	1.8×10^8	0	5.3×10^8
Ocean	2.6×10^9	1.0×10^9	2.5×10^8	2.5×10^8	0	6.1×10^8	4.0×10^8
Passaic	7.7×10^8	7.6×10^7	2.2×10^8	3.0×10^8	4.1×10^7	0	1.3×10^8
Salem	1.4×10^9	2.8×10^8	4.4×10^5	4.3×10^8	0	5.0×10^7	6.5×10^8
Somerset	1.0×10^9	1.4×10^7	1.9×10^8	0	5.3×10^8	0	2.6×10^8
Sussex	2.4×10^9	5.0×10^7	1.1×10^9	9.3×10^8	1.7×10^8	0	1.5×10^8
Union	4.1×10^8	9.8×10^7	1.5×10^7	1.0×10^8	1.8×10^8	0	2.0×10^7
Warren	1.4×10^9	3.3×10^7	7.1×10^8	2.6×10^8	2.5×10^8	0	1.2×10^8
Totals	$\mathbf{3.7 \times 10^{10}}$	$\mathbf{4.9 \times 10^9}$	$\mathbf{5.0 \times 10^9}$	$\mathbf{1.5 \times 10^{10}}$	$\mathbf{2.4 \times 10^9}$	$\mathbf{2.4 \times 10^9}$	$\mathbf{8.1 \times 10^9}$

Table 6. Midpoint monetary values of soil inorganic carbon (SIC) by soil order and county for the state of New Jersey (USA), based on the areas shown in Table 3 and the area-normalized midpoint monetary values in Table 4.

County	Total $SC\text{-}CO_2$ ($ = USD)	Degree of Weathering and Soil Development					
		Slight			Moderate	Strong	
		Entisols	Inceptisols	Histosols	Alfisols	Spodosols	Ultisols
		Soil Inorganic Carbon (SIC), $SC\text{-}CO_2$ ($ = USD)					
Atlantic	6.4×10^8	5.1×10^8	9.1×10^7	2.8×10^4	0	3.2×10^7	0
Bergen	1.8×10^8	4.2×10^7	4.1×10^7	2.7×10^7	7.0×10^7	0	0
Burlington	6.5×10^8	5.3×10^8	3.6×10^7	6.5×10^7	3.4×10^4	1.7×10^7	0
Camden	2.0×10^8	1.5×10^8	4.1×10^7	2.4×10^6	0	5.4×10^6	0
Cape May	2.8×10^8	1.0×10^8	1.6×10^8	9.3×10^6	0	1.0×10^7	0
Cumberland	3.5×10^8	1.2×10^8	1.8×10^8	3.5×10^7	0	1.0×10^7	0
Essex	1.9×10^8	5.5×10^7	8.8×10^7	1.1×10^6	5.0×10^7	0	0
Gloucester	1.3×10^8	8.2×10^7	1.7×10^7	2.9×10^7	0	4.3×10^5	0
Hudson	3.1×10^7	1.2×10^7	1.7×10^7	3.0×10^6	3.9×10^5	0	0
Hunterdon	4.9×10^8	1.2×10^7	1.9×10^8	0	2.9×10^8	0	0
Mercer	2.1×10^8	4.5×10^7	3.0×10^7	1.9×10^4	1.4×10^8	0.6	0
Middlesex	2.4×10^8	1.0×10^8	5.4×10^7	2.1×10^7	6.1×10^7	3.6×10^6	0
Monmouth	3.3×10^8	2.3×10^8	9.3×10^7	2.7×10^5	0	6.6×10^6	0
Morris	5.4×10^8	2.8×10^7	3.9×10^8	2.1×10^7	1.0×10^8	0	0
Ocean	8.1×10^8	6.3×10^8	1.4×10^8	4.3×10^6	0	2.9×10^7	0
Passaic	2.0×10^8	4.6×10^7	1.3×10^8	5.2×10^6	2.3×10^7	0	0
Salem	1.8×10^8	1.7×10^8	2.5×10^5	7.5×10^6	0	2.4×10^6	0
Somerset	4.2×10^8	8.3×10^6	1.1×10^8	0	3.0×10^8	0	0
Sussex	7.6×10^8	3.1×10^7	6.2×10^8	1.6×10^7	9.7×10^7	0	0
Union	1.7×10^8	6.0×10^7	8.7×10^6	1.7×10^6	1.0×10^8	0	0
Warren	5.8×10^8	2.0×10^7	4.1×10^8	4.5×10^6	1.4×10^8	0	0
Totals	$\mathbf{7.6 \times 10^9}$	$\mathbf{3.0 \times 10^9}$	$\mathbf{2.8 \times 10^9}$	$\mathbf{2.5 \times 10^8}$	$\mathbf{1.4 \times 10^9}$	$\mathbf{1.2 \times 10^8}$	**0**

3.3. Value of TSC (SOC + SIC) by Soil Order and County for New Jersey

Soil orders with the highest midpoint monetary value for TSC were Histosols ($15.0B), Ultisols ($8.0B), and Entisols ($8.0B) (Tables 7 and S3). The counties with the highest midpoint TSC values were Burlington ($6.9B), Cumberland ($3.8B), and Ocean ($3.4B) (Tables 7 and S3).

Table 7. Midpoint monetary values of total soil carbon (TSC) by soil order and county for the state of New Jersey (USA), based on the areas shown in Table 3 and the area-normalized midpoint monetary values in Table 4.

County	Total SC-CO_2 ($ = USD)	Degree of Weathering and Soil Development					
		Slight			Moderate	Strong	
		Entisols	Inceptisols	Histosols	Alfisols	Spodosols	Ultisols
		Total Soil Carbon (TSC), SC-CO_2 ($ = USD)					
Atlantic	2.7×10^9	1.4×10^9	2.5×10^8	1.7×10^6	0	6.9×10^8	4.1×10^8
Bergen	2.1×10^9	1.1×10^8	1.1×10^8	1.6×10^9	1.9×10^8	0	1.1×10^8
Burlington	6.9×10^9	1.4×10^9	1.0×10^8	3.8×10^9	9.5×10^4	3.7×10^8	1.2×10^9
Camden	9.7×10^8	4.0×10^8	1.1×10^8	1.4×10^8	0	1.2×10^8	2.0×10^8
Cape May	1.7×10^9	2.7×10^8	4.3×10^8	5.4×10^8	0	2.2×10^8	2.1×10^8
Cumberland	3.8×10^9	3.3×10^8	4.9×10^8	2.0×10^9	0	2.2×10^8	7.7×10^8
Essex	6.5×10^8	1.5×10^8	2.4×10^8	6.2×10^7	1.4×10^8	0	6.6×10^7
Gloucester	2.7×10^9	2.2×10^8	4.7×10^7	1.7×10^9	0	9.3×10^6	6.6×10^8
Hudson	2.5×10^8	3.1×10^7	4.5×10^7	1.7×10^8	1.1×10^6	0	0
Hunterdon	1.9×10^9	3.2×10^7	5.3×10^8	0	7.9×10^8	0	5.6×10^8
Mercer	9.2×10^8	1.2×10^8	8.3×10^7	1.1×10^6	3.8×10^8	1.3×10^1	3.3×10^8
Middlesex	2.3×10^9	2.7×10^8	1.5×10^8	1.2×10^9	1.7×10^8	7.7×10^7	4.3×10^8
Monmouth	1.9×10^9	6.1×10^8	2.5×10^8	1.6×10^7	0	1.4×10^8	8.6×10^8
Morris	3.2×10^9	7.5×10^7	1.1×10^9	1.2×10^9	2.8×10^8	0	5.3×10^8
Ocean	3.4×10^9	1.7×10^9	3.9×10^8	2.5×10^8	0	6.4×10^8	4.0×10^8
Passaic	9.7×10^8	1.2×10^8	3.5×10^8	3.1×10^8	6.4×10^7	0	1.3×10^8
Salem	1.6×10^9	4.6×10^8	6.9×10^5	4.4×10^8	0	5.2×10^7	6.5×10^8
Somerset	1.4×10^9	2.2×10^7	3.0×10^8	0	8.4×10^8	0	2.6×10^8
Sussex	3.1×10^9	8.1×10^7	1.7×10^9	9.5×10^8	2.7×10^8	0	1.5×10^8
Union	5.8×10^8	1.6×10^8	2.4×10^7	1.0×10^8	2.8×10^8	0	2.0×10^7
Warren	2.0×10^9	5.3×10^7	1.1×10^9	2.6×10^8	4.0×10^8	0	1.2×10^8
Totals	$\mathbf{4.5 \times 10^{10}}$	$\mathbf{8.0 \times 10^9}$	$\mathbf{7.8 \times 10^9}$	$\mathbf{1.5 \times 10^{10}}$	$\mathbf{3.8 \times 10^9}$	$\mathbf{2.5 \times 10^9}$	$\mathbf{8.0 \times 10^9}$

3.4. Land Use/Land Cover Change in New Jersey by Soil Order from 2001 to 2016

New Jersey had land use/land cover (LULC) changes during the 15 years (Table 8, Figure 3), causing soil-based GHG emissions. Changes varied by LULC classification and soil order, with most soil orders having losses in "low disturbance" LULC classes (e.g., evergreen forest, hay/pasture) while increasing the areas with "developed" LULC classes. Largest increases were in medium-intensity (+12.2%) and high-intensity (+7.5%) developed LULC classes (Table 8). Changes were different by soil orders as well. In high intensity developed LULC class, the largest increases were observed in the soil orders of Ultisols (+27.3%), Spodosols (+18.7%), and Alfisols (+15.8%). Alfisols are agriculturally important soils and should be reserved for agricultural purposes. The increase in the development of Histosols is somewhat alarming since these C-rich soils are often found in the wetlands and should be protected at both state and federal regulatory levels.

Overall, NJ's forest LULC extent was lowered across all forest categories between 2001 and 2016 (Table 8), which likely represents reduced overall C sequestration in these forests. This study found declines in wetlands during the 15-year time period, with the greatest losses occurring in the category representing emergent herbaceous wetlands (Table 8). In addition, hay/pasture and cultivated LULC classes were reduced as well. Cultivated crops per person were 0.03 ha per person in 2016. Our results are similar to the results of other studies conducted in NJ previously. For example, Ngoy et al. (2021) [25] documented gains in developed areas and losses in cultivated and forested areas in NJ from 2007 to 2012. This study also conducted an analysis to predict land-use change in 2100, which showed that the urbanization trend would continue at the expense of cultivated areas [24]. Future predictions should examine the loss of areas due to sea-level rise, affected populated areas, and availability of land for relocating population and infrastructure affected by the sea rise considering that most of NJ land is privately owned (81.7%) [14].

Table 8. Change in land use/land cover (LULC) by soil order in New Jersey (USA) from 2001 to 2016.

NLCD Land Cover Classes (LULC)	2016 Total Area by LULC (km^2) (Change in Area, 2001–2016, %)	Degree of Weathering and Soil Development					
		Slight			Moderate	Strong	
		Entisols	Inceptisols	Histosols	Alfisols	Spodosols	Ultisols
		2016 Area by Soil Order, km^2 (Change in Area, 2001–2016, %)					
Barren land	53.9 (−11.9)	17.3 (−11.9)	3.6 (−14.8)	7.2 (2.0)	2.8 (−27.6)	6.5 (−6.7)	16.5 (−18.9)
Woody wetlands	3180.1 (0.3)	775.9 (0.3)	885.9 (0.1)	351.6 (2.2)	152.1 (−0.9)	342.5 (−0.2)	672.1 (−0.7)
Shrub/Scrub	124.1 (−23.4)	30.0 (−23.4)	13.0 (30.5)	0.8 (−1.2)	9.8 (−0.4)	11.5 (−40.1)	58.9 (−17.3)
Mixed forest	1043.0 (−0.9)	300.5 (−0.9)	107.7 (−1.2)	3.6 (−1.4)	56.3 (−0.6)	141.7 (−0.3)	433.3 (−0.9)
Deciduous forest	3582.8 (−7.4)	340.2 (−7.4)	1134.0 (−1.7)	14.9 (−8.0)	519.0 (−3.3)	114.4 (−7.7)	1460.2 (−4.3)
Herbaceous	105.1 (9.5)	33.3 (9.5)	10.5 (54.5)	3.4 (3.5)	6.3 (7.2)	11.6 (29.0)	40.0 (−3.7)
Evergreen forest	777.4 (−1.5)	328.5 (−1.5)	20.6 (−2.0)	1.8 (−3.2)	6.6 (−5.5)	141.5 (0.6)	278.3 (0.1)
Emergent herbaceous wetlands	797.7 (−2.0)	514.6 (−2.0)	68.7 (−6.4)	148.4 (−5.6)	2.5 (−26.8)	8.3 (−12.3)	55.2 (−8.3)
Hay/Pasture	827.3 (−15.5)	17.7 (−15.5)	252.7 (−6.3)	2.6 (−28.8)	280.1 (−8.9)	2.0 (−12.0)	272.3 (−10.7)
Cultivated crops	1788.8 (−4.0)	164.8 (−4.0)	98.7 (3.3)	7.0 (7.1)	163.0 (3.8)	82.2 (−2.6)	1273.1 (−5.6)
Developed, open space	351.1 (1.5)	144.4 (1.5)	42.1 (2.4)	4.0 (2.0)	25.9 (3.9)	27.3 (2.0)	107.4 (5.3)
Developed, medium intensity	1589.3 (12.2)	355.6 (12.2)	184.1 (13.3)	22.4 (15.4)	216.7 (15.8)	105.7 (18.7)	704.8 (27.3)
Developed, low intensity	869.6 (4.4)	274.2 (4.4)	111.2 (4.0)	13.9 (3.7)	102.3 (5.1)	57.7 (5.2)	310.4 (9.8)
Developed, high intensity	2284.6 (7.5)	367.4 (7.5)	370.4 (12.6)	38.1 (24.3)	367.9 (19.1)	112.8 (10.7)	1028.0 (27.8)

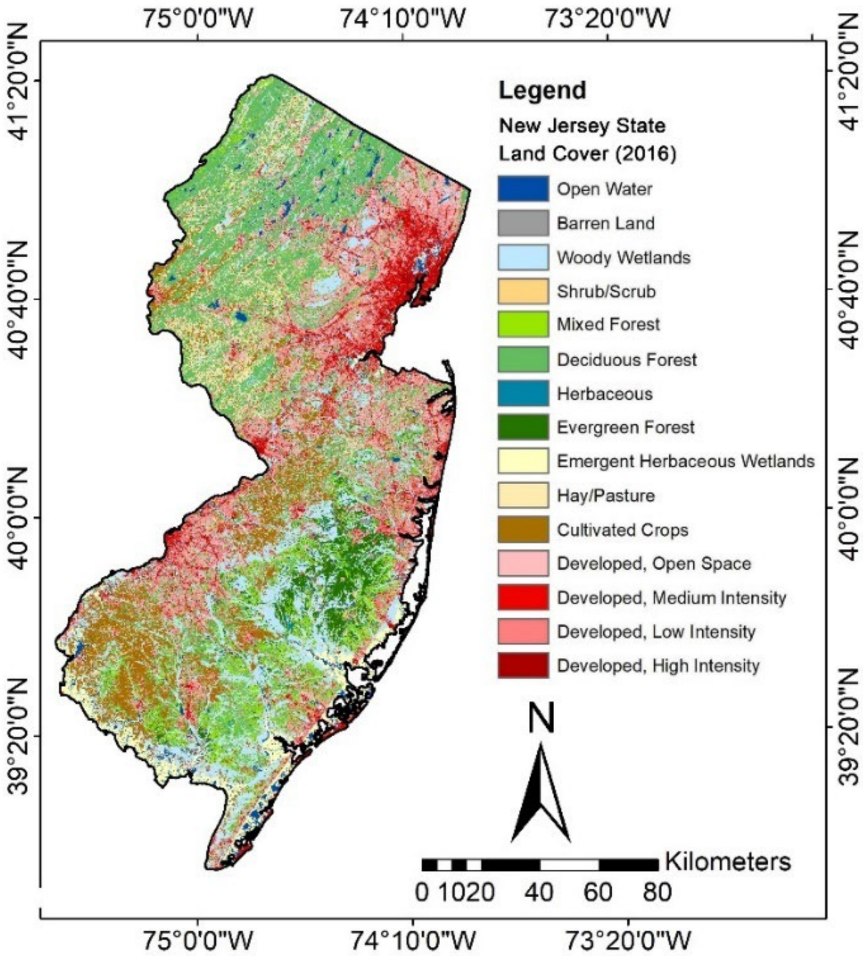

Figure 3. Land cover map of New Jersey (USA) for 2016 (Latitude: 38°56′ N to 41°21′ N; Longitude: 73°54′ W to 75°34′ W) (based on data from MRLC [21]).

4. Significance of Results

4.1. Importance of Results for New Jersey's GHG Emissions Inventory and Global Warming Response Act

New Jersey leaders recognize climate change's dangers to the state, the nation, and the world. The NJ legislature and governor have imposed ambitious goals for reducing GHGs. The governor has issued an executive order that the state reduces GHG levels 50% below 2006 levels by 2030 [3]. The legislature has required an 80% reduction by 2050 [3]. However, the governor and legislature have done little to achieve these goals, as environmental groups now complain in a lawsuit [26]. Strong words but little action is consistent with the impacts of the many COIs that impede progress on climate change.

Our study shows that current NJ's GHG inventory does not include the state's soil regulating services (Table 9), which are necessary to determine GHG emissions from soil because of land conversions. Our study showed that soil-based emissions from land conversions in NJ from 2001 to 2016 resulted in a calculated CF value of $681.1 M, with 39% linked to medium-intensity developments ($267.3 M) (Table 10). The Ultisols soil order generated the largest social costs of C ($245.7 M) in all development class categories (Table 10). The Ultisols comprise the largest area in NJ (39% of the total state area) (Table 3). Spatial analysis showed that the highest social costs of C emissions associated with land conversions were found in Ocean ($91.2 M), Middlesex ($76.7 M), and Morris ($63.2 M) counties (Table 11, Figure 4a).

Table 9. Distribution of soil carbon regulating ecosystem services in the state of New Jersey (USA) by soil order (photos courtesy of USDA/NRCS [27]).

Soil Regulating Ecosystem Services in the State of New Jersey					
Degree of Weathering and Soil Development					
Slight 43%			**Moderate 11%**	**Strong 46%**	
Entisols 21%	**Inceptisols 19%**	**Histosols 3%**	**Alfisols 11%**	**Spodosols 7%**	**Ultisols 39%**
					
Social cost of soil organic carbon (SOC): $37.4 B					
$4.9 B	$5.0 B	$14.6 B	$2.4 B	$2.4 B	$8.1 B
13%	13%	39%	6%	6%	22%
Social cost of soil inorganic carbon (SIC): $7.6 B					
$3.0 B	$2.8 B	$253.5 M	$1.4 B	$116.5 M	$0.0
40%	37%	3%	18%	2%	0%
Social cost of total soil carbon (TSC): $45.0 B					
$8.0 B	$7.8 B	$14.9 B	$3.8 B	$2.5 B	$8.0 B
18%	17%	33%	8%	6%	18%
Sensitivity to climate change					
Low	Low	High	High	Low	Low
SOC and SIC sequestration (recarbonization) potential					
Low	Low	Low	Low	Low	Low

Note: Entisols, Inceptisols, Alfisols, Spodosols, and Ultisols are mineral soils. Histosols are mostly organic soils. M = million = 10^6; B = billion = 10^9.

Table 10. Increases in developed land and maximum potential for realized social costs of carbon due to complete loss of total soil carbon (TSC) of developed land by soil order in New Jersey (USA) from 2001 to 2016.

NLCD Land Cover Classes (LULC)	Degree of Weathering and Soil Development					
	Slight			Moderate	Strong	
	Entisols	Inceptisols	Histosols	Alfisols	Spodosols	Ultisols
	Area Change, km^2 (SC-CO_2, $ = USD)					
Developed, open space ($143.5 M)	5.3 ($11.5 M)	8.5 ($20.1 M)	0.7 ($17.6 M)	13.8 ($27.5 M)	2.2 ($4.8 M)	51.7 ($62.0 M)
Developed, medium intensity ($267.3 M)	29.8 ($64.7 M)	13.1 ($30.8 M)	1.9 ($44.5 M)	13.9 ($27.8 M)	9.1 ($19.7 M)	66.5 ($79.8 M)
Developed, low intensity ($176.5 M)	14.9 ($32.2 M)	7.1 ($16.7 M)	0.8 ($19.4 M)	10.6 ($21.1 M)	5.2 ($11.3 M)	63.2 ($75.8 M)
Developed, high intensity ($93.7 M)	10.0 ($21.9 M)	4.7 ($11.1 M)	0.8 ($18.6 M)	4.2 ($8.3 M)	2.6 ($5.7 M)	23.4 ($28.1 M)
Totals 364 km^2 ($681.1 M)	**60.1 ($130.3 M)**	**33.4 ($78.7 M)**	4.2 ($100.1 M)	**42.5 ($84.7 M)**	**19.1 ($41.5 M)**	**204.8 ($245.7 M)**

Note: Entisols, Inceptisols, Alfisols, Spodosols, and Ultisols are mineral soils. Histosols are mostly organic soils. M = million = 10^6.

Table 11. Increases in land development (LULC: developed open space, developed medium intensity, developed low intensity, and developed high intensity) and maximum potential for realized social costs of C due to complete loss of total soil carbon (TSC) of developed land by soil order and county in New Jersey (USA) from 2001 to 2016.

County	Degree of Weathering and Soil Development					
	Slight			Moderate	Strong	
	Entisols	Inceptisols	Histosols	Alfisols	Spodosols	Ultisols
	Developed Area Increase between 2001 and 2016 (km^2) (SC-CO_2, $ = USD)					
Atlantic	9.9 ($21.4 M)	0.03 ($78,588.0)	0	0	3.4 ($7.4 M)	7.8 ($9.3 M)
Bergen	1.9 ($4.2 M)	1.8 ($4.2 M)	1.5 ($36.7 M)	3.9 ($7.8 M)	0	2.7 ($3.2 M)
Burlington	2.3 ($4.9 M)	0.3 ($787,900.8)	0.06 ($1.6 M)	0.01 ($19,900.0)	1.3 ($2.7 M)	32.6 ($39.2 M)
Camden	2.4 ($5.3 M)	0.8 ($1.9 M)	0.01 ($240,300.0)	0	0.6 ($1.3 M)	5.7 ($6.9 M)
Cape May	1.1 ($2.3 M)	0.5 ($1.3 M)	0.11 ($2.6 M)	0	0.8 ($1.8 M)	2.5 ($2.9 M)
Cumberland	0.6 ($1.3 M)	1.6 ($3.7 M)	0.07 ($1.6 M)	0	1.1 ($2.5 M)	5.9 ($7.1 M)
Essex	1.3 ($2.8 M)	1.6 ($3.8 M)	0.01 ($240,300.0)	3.3 ($6.6 M)	0	0.8 ($1.0 M)
Gloucester	3.9 ($8.4 M)	0.9 ($2.1 M)	0.4 ($9.1 M)	0	0	30.7 ($36.8 M)
Hudson	0.7 ($1.6 M)	0.8 ($1.9 M)	0.4 ($9.1 M)	0.01 ($19,900.0)	0	0
Hunterdon	0.1 ($119,132.9)	1.3 ($3.2 M)	0	4.5 ($8.9 M)	0	7.6 ($9.2 M)
Mercer	1.0 ($2.1 M)	0.3 ($616,351.8)	0	4.0 ($8.0 M)	0	18.0 ($21.6 M)
Middlesex	3.3 ($7.3 M)	1.6 ($3.7 M)	1.1 ($26.0 M)	2.5 ($4.9 M)	1.3 ($2.9 M)	26.6 ($32.0 M)
Monmouth	6.9 ($15.0 M)	3.7 ($8.7 M)	0	0	2.4 ($5.3 M)	33.4 ($40.1 M)
Morris	1.2 ($2.6 M)	9.2 ($21.6 M)	0.4 ($9.4 M)	2.7 ($5.3 M)	0	20.2 ($24.3 M)
Ocean	21.5 ($46.7 M)	1.0 ($2.5 M)	0.2 ($4.9 M)	0	8.8 ($19.1 M)	15.0 ($18.0 M)
Passaic	0.9 ($2.0 M)	2.2 ($5.1 M)	0.12 ($2.8 M)	4.3 ($8.7 M)	0	0.6 ($721,668.4)
Salem	1.2 ($2.5 M)	0	0.01 ($240,300.0)	0	0.03 ($54,684.0)	2.3 ($2.8 M)
Somerset	0.5 ($1.0 M)	2.0 ($4.7 M)	0	12.9 ($25.6 M)	0	6.6 ($7.9 M)
Sussex	1.0 ($2.2 M)	4.3 ($9.3 M)	0	2.1 ($2.2 M)	0	0.8 ($942,869.9)
Union	1.1 ($2.4 M)	0.1 ($165,200.0)	0.01 ($240,300.0)	1.3 ($2.6 M)	0	0.1 ($108,000.0)
Warren	0.4 ($779,246.7)	1.2 ($2.8 M)	0	5.2 ($10.3 M)	0	0.3 ($405,000.2)
389.7 km^2 ($722.2 M)	**63.1 ($136.8 M)**	**35.2 ($82.1 M)**	**4.4 ($104.8 M)**	**46.7 ($90.9 M)**	**19.9 ($43.1 M)**	**220.4 ($264.5 M)**

Note: Entisols, Inceptisols, Alfisols, Spodosols, and Ultisols are mineral soils. Histosols are mostly organic soils. M = million = 10^6.

A report solicited by New Jersey's government concluded that, unless strong action is taken, a 50% chance exists both that sea levels will rise by more than five feet, inundating many of the state's coastal areas, and that Atlantic City is predicted to experience flooding 355 days per year [8]. Figure 4b provides further projections of the substantial rise in sea level that climate change will cause in New Jersey. Table 12 shows area losses due to sea rise in NJ counties affected by sea rise. Cape May, Cumberland, Hudson, and Salem counties are projected some of the worse area losses due to sea rise (Table 12). Projected sea-level rise impacts will likely reach coastal areas with densely populated urban areas throughout NJ, and the low proportion of available public land limits opportunities for relocation. Damages to urban infrastructure and the cost of relocation will burden both the government and the citizens of NJ. Our results are consistent with reports by the nonprofit organization Climate Central, which predicts that 4.4 million acres of land, 650,000 properties, and $34B in real estate value along the U.S. coasts are projected to be below tidal area boundaries over the subsequent 30 years [28]. According to the same report, Hudson County (NJ) has the highest estimated land value at risk with more than $2.4B in projected losses. Payments for soil-based "realized" SC-CO_2 emissions from land conversions in NJ can be one of the solutions to help alleviate costs associated with climate change damages, however, this will only cover a tiny fraction of the costs of damages because of its non-market-based fixed cost per unit of GHG emission. In other states, ocean-front homes are already washing away [29]. Moreover, climate change is contributing to substantial parts of NJ being incinerated. For example, wildfires recently burned 12,000 acres of NJ's Wharton State Forest, located just 20 miles northwest of Atlantic City and divided between Atlantic, Burlington, and Camden counties [30].

In NJ, climate change tends to strike where it can inflict significant economic damage. This is because economic forces induce development in the areas that are most vulnerable to climate change (Figure 4). Areas next to the ocean are often desirable for residential and commercial development; many people prefer to live near the ocean, and businesses tend to locate where people like to live. Just like proximity to the ocean attracts development, so can proximity to parks and protected forests. Just as development near the ocean is most vulnerable to rising sea levels, development near forests is vulnerable to fire; old forests are filled with fuel for flames.

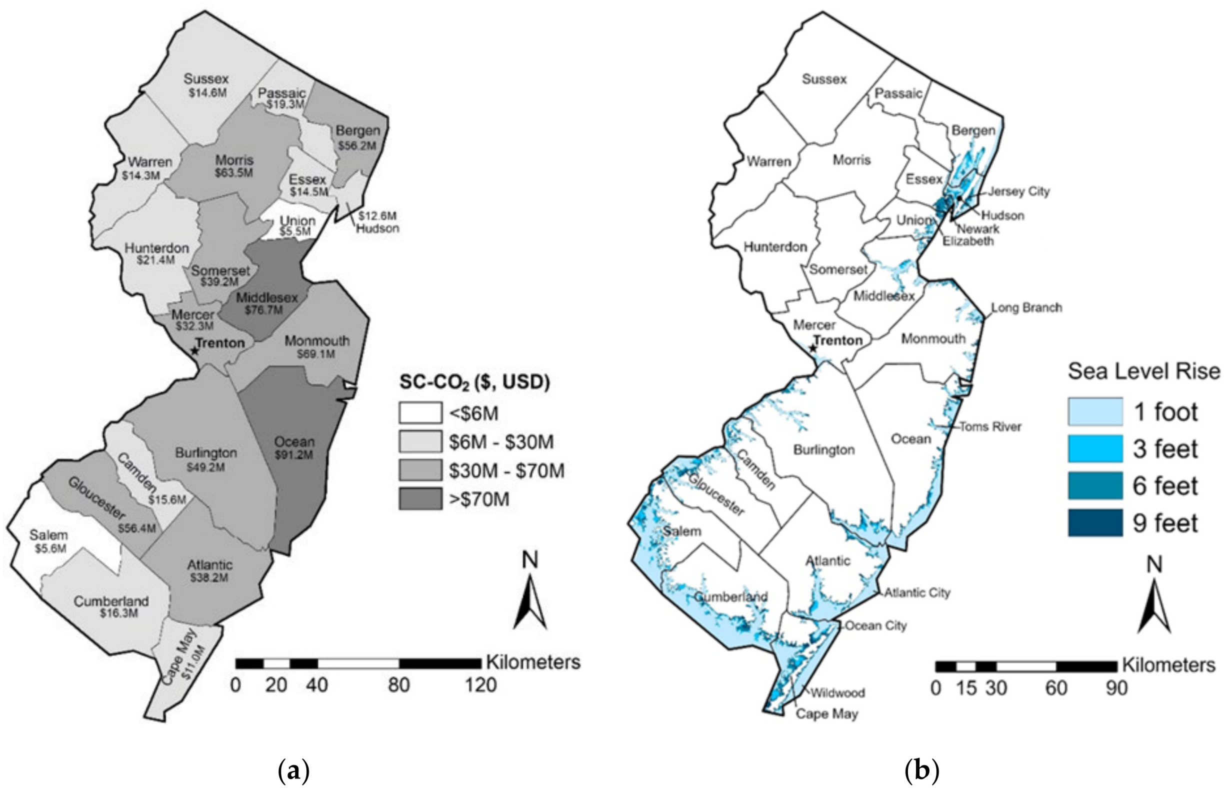

Figure 4. (**a**) Detection and attribution map of realized social cost of C because of land conversions in New Jersey (USA). Realized total dollar value of mid-point total soil carbon (TSC) for newly "developed" land covers (open space, low, medium, and high intensity) from 2001 to 2016 in New Jersey by county based on a social cost of C (SC-CO_2) of $46 per metric ton of CO_2 applicable for the year 2025 (2007 U.S. dollars with an average discount rate of 3% [1]). Total value for the state is $722.2 M. (**b**) Projections of future sea rise due to climate change in New Jersey (USA).

Table 12. County area loss (%) due to sea rise in the state of New Jersey (USA) (based on original ArcGIS Pro 2.6 [23] analysis of data from the National Oceanic and Atmospheric Administration (NOAA) [31]).

County (Affected by Sea Rise)	County Area Loss Due to Sea Rise (% County Area)			
	1 Foot	3 Feet	6 Feet	9 Feet
Atlantic	11.9	13.5	15.7	17.8
Bergen	6.3	8.7	11.7	13.2
Burlington	3.9	4.8	6.0	7.2
Camden	2.7	3.2	4.8	6.0
Cape May	32.9	37.9	45.1	53.8
Cumberland	24.0	26.9	30.5	33.5
Essex	1.0	1.0	4.0	7.9
Gloucester	6.2	7.5	9.7	11.7
Hudson	22.3	27.1	42.0	54.2
Mercer	1.7	1.8	2.0	2.1
Middlesex	2.8	3.9	5.1	6.4
Monmouth	1.7	2.0	3.0	4.1
Ocean	9.3	10.7	12.8	14.5
Passaic	0.1	0.1	0.1	0.2
Salem	18.5	22.9	27.6	31.2
Union	2.1	2.7	5.0	8.0

The potential future sea rises and increases in urban developments will decrease soil and plant-based C sequestration potential in NJ. Soils of NJ have inherently low C sequestration potential because they are dominated by strongly (46%) and slightly (43%) weathered soils (Table 9). Highly leached and low fertility Ultisols (39%) are the most dominant soil order in the state (Table 9). There are also limited new opportunities for soil and plant-based C sequestration in the state based on the intersection of land cover and soil type (Table 13), which shows that the barren land, shrub/scrub, and herbaceous land cover categories combined only comprise 1.6% of the total land area. Within the barren LULC, Histosols occupy 13.5% of the area, which should be protected from land conversions because of their C-rich content (Table 13). Shrub/scrub, and herbaceous LULCs also contain Histosols, but in lesser proportions: 0.6% and 3.3%, respectively, (Table 13). The potential conversion of agricultural land uses (cultivated crops, hay/pasture) to forestry land use for C sequestration will reduce the potential for food production.

Table 13. Land use/land cover (LULC) by soil order in New Jersey (USA) in 2016.

NLCD Land Cover Classes (LULC)	2016 Total Area by LULC (%)	Degree of Weathering and Soil Development					
		Slight			Moderate	Strong	
		Entisols	Inceptisols	Histosols	Alfisols	Spodosols	Ultisols
		2016 Area by Soil Order, % from Total Area in Each LULC					
Barren land	0.3	32.1	6.8	13.4	5.1	12.0	30.6
Woody wetlands	18.3	24.4	27.9	11.1	4.8	10.8	21.1
Shrub/Scrub	0.7	24.2	10.5	0.6	7.9	9.3	47.5
Mixed forest	6.0	28.8	10.3	0.3	5.4	13.6	41.5
Deciduous forest	20.6	9.5	31.7	0.4	14.5	3.2	40.8
Herbaceous	0.6	31.7	10.0	3.3	6.0	11.1	38.0
Evergreen forest	4.5	42.3	2.6	0.2	0.9	18.2	35.8
Emergent herbaceous wetlands	4.6	64.5	8.6	18.6	0.3	1.0	6.9
Hay/Pasture	4.8	2.1	30.5	0.3	33.9	0.2	32.9
Cultivated crops	10.3	9.2	5.5	0.4	9.1	4.6	71.2
Developed, open space	2.0	41.1	12.0	1.1	7.4	7.8	30.6
Developed, medium intensity	9.1	22.4	11.6	1.4	13.6	6.7	44.3
Developed, low intensity	5.0	31.5	12.8	1.6	11.8	6.6	35.7
Developed, high intensity	13.1	16.1	16.2	1.7	16.1	4.9	45.0

4.2. Significance of Results in Broader Context

4.2.1. The Problem of Conflicts of Interest (COI) in Addressing Climate Change

A conflict of interest causes a decision-maker to choose an alternative to what they would otherwise do because the alternative is in their own personal interest. Conflicts of interest are not unusual. "Conflicts and their potential to influence decisions are ubiquitous. . . . Conflicts of interest are part of the 'human condition,' a consequence of the tension between man as a social and political creature, and man as self-interested and acquisitive" [32].

Conflicts of interest are pernicious because they eliminate trust. The public cannot determine whether decision-makers are acting in the public interest or acting to further their self-interest. "Conflicts of interest can damage trust. They do this in two ways: by creating suspicion if a conflict is exposed but not previously declared, and through biased judgments or behaviors influenced by a conflict" [33]. Trust is destroyed because the decision-makers always claim that they are acting in the public interest, even when they are not. "Evidence of bias is often obscure; this may be because it is deliberate scientific fraud by individuals or industry, or because it is implicit and subconscious or part of a dysfunctional group culture, and therefore unrecognized by [decision-makers] themselves" [32].

To an extraordinary level, attempts to control global warming are infused with COIs that impede progress. Conflicts take many forms. However, they combine to be an important force in preserving the status quo, thwarting attempts to alter the world's accelerating slide toward climate disaster. Experts have summarized the conditions for when the effects of COI will be most harmful, listing factors for when COI will have the greatest impact: "Ineffective governance; maximization of profit; poor ethical climate... poor role models normalized" [32]. As we now explore, all of these factors pervade the arena of climate change. Conditions are perfect for the impact of COI to be deeply harmful.

A. The many conflicts

As demonstrated by the following list of nine conflicts—a list that is certainly incomplete—COI are pervasive in the arena where climate-change policy is debated; the debate is distorted by a toxic tangle of conflicts. Despite a clear scientific consensus on the need for action on climate change, it is no surprise that pervasive conflicts impede progress.

(1) Economic conflicts of interest for politicians. Many leaders who influence policy responding to climate change personally benefit from impeding action on climate change. GHGs are emitted by a host of business activities, such as coal and oil production and food production (e.g., the production of beef is a major source of GHGs). Indeed, almost all businesses are implicated because almost all businesses in some way use vehicles and power sources that burn fossil fuels. This paper measures the GHG emissions of yet another business activity: the disturbance of soil through development.

To remain in office, politicians need financial support. The source of much of the support is campaign contributions from businesses. A politician's decision to limit GHGs through limiting business activity harms the businesses that support the politician. A politician imposes such GHG limits at the peril of losing these businesses' financial support. Politicians who support strong measures risk angering business interests, which will cut off the politicians' financial lifeblood, supporting their compliant rivals instead. Moreover, the personal livelihoods of a substantial number of decision-makers rely on the continued use of fossil fuels [34,35].

(2) Intergenerational conflicts of interest. Morally, we should care as much about protecting the interests of our children and grandchildren, as our own interests; it would be immoral to destroy the world's climate for our grandchildren, to further our own needs. However, decision-makers frequently are willing to forfeit the interests of future generations if preventing catastrophic climate change would cause even modest costs for the world's current inhabitants. Although we should view the interests of our grandchildren as equal to our own, we do not; instead, the decision-makers' personal interests are to favor the current generation because the decision-makers are themselves part of this generation.

Leaders routinely favor their own interests over the interests of others who will live later, stating, for example, “who cares if Miami is six meters underwater in 100 years?” [36]. Just as COI cause decision-makers with links to oil companies improperly to favor oil companies over the general public, decision-makers with links to the current generation improperly favor this generation over all people, including people who will inherit the earth from us years from now.

(3) Conflicts of interest between property owners and the public. Opposition to effective environmental programs can arise because of COI created by details of property law. For example, one might expect that owners of beachfront homes where the beach has eroded because of rising sea levels might support expensive public efforts to “renourish” the beaches by pumping in sand from the ocean floor. However, the property owners can instead oppose public renourishment projects in Florida and some other states, if the state’s law provides that the renourished beach will belong to the state. Because the state will now own the new strip of land next to the beach, and could conceivably sell it or build on it, the property owner will no longer own beachfront property [37].

Similarly, legal details can sometimes create COIs that reduce government officials’ incentives to protect against climate change. Suppose that rising sea levels will inundate land that was formerly privately owned, transforming it into tidal wetlands. The law in most states provides that the wetlands will now be owned by the government, not the former owners of the dry land. Because the government will benefit from this impact of rises in sea levels, government officials have an incentive not to seek measures for fighting climate change as much as they otherwise would [37].

(4) Political conflicts for voters. The defining characteristic of many voters of a particular political party can be a belief that humans have not caused climate change [38]. To many members of such parties, to express a belief in anthropogenic climate change would be to deny one’s identity as a member of such a political party. A conflict of interest thus arises for some party members who have read and absorbed the consensus scientific literature that demonstrates that anthropogenic climate change exists. To express their belief in humans’ role in climate change would be to abandon their political party’s identity. For many, climate-change denial has become a creed of faith, not an issue of science. To deny this creed is to deny a fundamental tenet of the political party, to become an apostate, and to risk rejection from the community that, in part, defines itself by climate-change denial. This creates a COI that will cause even voters who secretly understand that humans cause climate change to express the opposite and to support political candidates who themselves deny climate change. Progress on reducing climate change is terminated by the conflict between some voters’ scientific understanding and the faith-creed of denial that they must express to remain members in good standing of their political community.

(5) Political conflicts for politicians. To be elected, some politicians must adhere to the tenets of their party’s faith, including climate denial [39]. Because climate denialism is an essential requirement for membership in such a community, politicians recognize that public acceptance of the consensus on climate science would constitute political suicide. A political candidate who rejects this essential tenet of the party’s faith doctrine can expect rejection by the party’s faithful voters.

Politicians who privately acknowledge the existence and dangers of anthropogenic climate change suffer a stark COI. Their self-interest in being reelected and keeping their jobs conflicts with their understanding of the importance of supporting legislation to reduce climate change. The lack of progress on climate-change legislation suggests that self-interest can often prevail.

(6) Conflicts for academic scientists. Conflicts of interest can also distort academic research [40]. Academic research can be a victim of COIs, where research is supported by industry. These conflicts can lead researchers to slant their results to benefit the industry that supports them. For example, scientists who are supported by oil companies may strain to produce results that deny anthropogenic climate change.

Some scientists may become climate-denial entrepreneurs, attracting lavish support from the industry by providing scientific results that benefit the industry. "Evidence of bias is often obscure; this may be because it is deliberate scientific fraud by individuals or industry, or because it is implicit and subconscious or part of a dysfunctional group culture, and therefore unrecognized by [decision-makers] themselves" [32].

Indeed, similar COIs may infect journal editors' decisions on which articles to publish. "Journals receive substantial income from industrial sponsors, and editors may also receive honoraria or consultancy fees, many of which are undeclared. The dependence of these organizations on the industry is unlikely to be completely free of risk of bias" [32].

(7) Conflicts in media. Conflicts abound in media [41] because any desire that conservative content providers' might have to express the consensus existence of anthropogenic climate change conflicts with their incentive to express the climate change denial that is part of conservatives' core beliefs [37]. As in academic science, some reporters and commentators may become climate-denial entrepreneurs, benefitting themselves and their employers by expressing to their conservative audience the climate-denial views that conservatives prefer—regardless of whether their expressed views conflict with their true views. These conflicts are not limited to conservative commentators. Liberal content providers may similarly shape their commentary to comply with liberal audiences' preferences, even if the commentary conflicts with the content providers' own views.

(8) Conflicts due to competition among states. Although many states have the incentive to benefit their populations by reducing GHGs, they may also have the opposite tendency because of an incentive to attract industry and land developers from other states. For example, states often compete with each other to lure industry. To attract fossil-fuel companies, a state must have relaxed climate-change policies—even if these lax policies conflict with the stricter approach the state would otherwise pursue to protect its economy and its citizens' health [42].

(9) Conflicts between development and climate change. Our results demonstrate that development contributes to climate change by disturbing the soil and releasing GHGs. However, development also benefits the state by providing income, jobs, and taxes. A COI thus exists for NJ policymakers. Their desire to control climate change conflicts with their desire to promote development, which will help the economy in the short term. Because policymakers must appeal to voters in the short term, this conflict causes policymakers to sacrifice the state's long-term interests in reducing climate change to policymakers' interest in being reelected.

B. What can be done?

Because of the number and strength of the conflicts, it will be difficult to eliminate the distortions that the conflicts impose on the climate-change debate. The best that can be hoped is that the conflicts can be managed to a degree. The first step to managing the conflicts would be to identify them and acknowledge them. Because conflicts are ubiquitous, "the challenge is not necessarily to prevent or eradicate potentially conflicted relationships, but to recognize, reveal, and manage them" [30]. Thus, an important step would be to compel groups and individuals to reveal their COIs. In addition, public officials should be tasked with investigating and exposing conflicts that are not revealed voluntarily.

Experts recommend not only the disclosure of COIs, but also the exclusion of conflicted decision-makers from the decision-making process. "The key components for managing conflicts of interest are disclosure (transparency) and distance (separation of roles, prohibition)" [31]. However, such exclusion will often not be possible in climate-change policymaking. For example, conflicted politicians cannot be excluded from the legislative process. Nor can conflicted members of the press be silenced.

Finally, decision-makers cannot be trusted to recuse themselves from conflicted decisions. "At the individual level, people with conflicts could recuse themselves from participating in specific activities. However, self-censoring is an unreliable basis for this approach" [31]. The murky quagmire of conflicts that engulfs climate-change policy may delay, if not kill, efforts to cure climate change. Perhaps when climate change worsens sufficiently and the entire world economy is threatened, policymakers will finally act; their conflicted self-interest will finally be dwarfed by existential dangers. Until then, the prospects for meaningful progress are small.

Our paper reveals an important COI, but also provides a partial solution to its impacts. We show that development contributes to climate change by disturbing the soil and releasing GHGs. However, development also benefits the state by providing income, jobs, and taxes. A COI thus exists for NJ policymakers: they may favor development to improve the economy in the short term and increase their chances of reelection—although this choice hurts the state in the long term.

Our study may help to moderate this COI's impact. Because our study provides precise estimates of land disturbance's costs, the policymaker and the public will be aware of the costs of development, not just the benefits. This may reduce policymakers' willingness to approve development that will impose large environmental costs.

Ideally, the state would impose development fees that include the development's environmental costs. However, because of COIs, policymakers may choose not to impose these fees. The fees might deter development, reduce economic activity and the number of jobs, and irritate developers on whom the policymakers rely for political and financial support.

4.2.2. The Role of Conflicts of Interest (COI) in Climate Change Litigation

The previous section has highlighted that COI are very often ignored when addressing climate change, which can then result in further conflicts such as litigation (Figure 5). Conflicts of interest are just part of many conflicts associated with climate change worldwide. These COIs are often overlooked in climate change policies worldwide, therefore "ignoring the behavioral characteristics" [43] of climate change. We propose an intensity spectrum of COI (Figure 5), which illustrates the role of COI in potential climate-change litigation. Profits from new developments and the associated government tax revenues likely incentivize further development and the permitting process. The market plays an important role in land development, driven by profit potential. While profits are a known part of this process, there is no market information about the environmental costs including damages from GHG emissions. Recently the U.S. EPA introduced the social cost of carbon which provides a method to calculate the cost of GHG emissions associated with development. This allows the direct estimation of damages linked to land conversions for developments. Assigning the monetary value to each side of a COI makes the COI no longer an abstract concept but can be included in a quantifiable cost-benefit analysis. Furthermore, this information may define COIs that were not previously understood. It is important to note that damages associated with land conversions can include consequences of climate change (e.g., flooding, sea-level rise, etc.) which may be much higher than the calculated social cost of carbon. Sea-level rise may increase the market value of "climate-safe" land, making adaptation more expensive. The SC-CO_2 value does not reflect these market values. In Figure 5, in the case where there is no COI, there can be still damages from land conversion emissions. For example, even if there is an agreement between relevant parties that there is no climate change impact from land conversions, human opinions do not influence the actual soil-based emissions. Since GHG emissions are within administrative boundaries and can cause damages beyond where the parties subject to a COI have control, the agreement of parties does not provide immunity from legal action initiated, for example, outside of this administrative area. In case of moderate COIs, willingness to compromise on COI can reduce litigation (Figure 5). Strong divergence in interests, climate change-related damages, and unwillingness to compromise on COI can lead to litigation (Figure 5). This may be the case of the recent lawsuit filed by the NJ environmental groups against the governor of NJ for lack of action on climate change [26] (Figure 5).

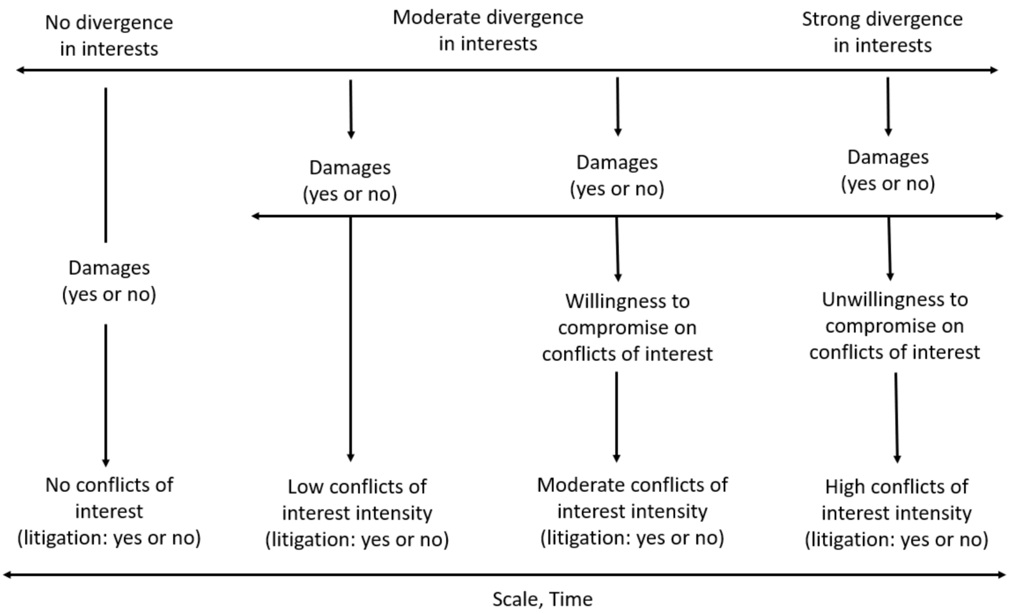

Figure 5. Intensity spectrum of conflicts of interest (COI) and potential climate change litigation (modified from Weible and Heikkila (2017) [44]).

In the case of land conversions, private developers or their organizations may try to influence future regulations that could limit or restrict development because of potential GHG emissions. Additionally, government officials could have a personal interest in land development, beyond the desire for increased property tax income. Companies previously worked to limit climate change regulations through intensive lobbying efforts [43]. These companies through their lobbying efforts may both represent undue influence [43] and also cause a COI for public figures if these officials receive campaign contributions from companies opposing climate change legislation and simultaneously are in a position to create legislation to limit climate change impacts [43]. This is an interesting type of COI because politicians can be personally enriched as part of a COI while the government itself has a COI between receiving additional tax revenues and fulfilling net zero emissions promises. Without disclosures about potential future emissions associated with land conversions, there is no monetary information to define the potential harm associated with future admissions. Once disclosures have been made, new COIs become more evident as does public officials' responsibility to work in the public interest and to consider the harm from emissions associated with land conversions.

These disclosures are also crucial for loss and damage assessment [45]. Loss is defined as permanent loss (e.g., land loss from sea level rise, etc.) and for example in the state of NJ this loss could be represented by land loss from sea level rise in 16 out of NJ's 21 counties. Damage involves repairable damages, for example, hurricane Sandy (2012) caused more than $29.5B worth of damages for NJ [46]. This amount of damage, from just one catastrophic event, was covered by federal disaster assistance, which may represent another COI where the burden of damage mitigation is distributed at the federal level, while contributors to GHG emissions had no cost (e.g., no cost related to soil-based GHG emissions in NJ).

It is important to note that COIs related to GHG emissions from land developments can potentially be reduced by leveraging the techniques presented in this study to account for emissions before development. Development focused on low-carbon soil types could limit GHG emissions and the resulting COI from emissions. Urban ecosystems offer numerous such opportunities [47]. For example, redeveloping brownfield (abandoned industrial properties with environmental contamination) and greyfield (former commercial shopping locations) sites may result in fewer GHG emissions because most GHG emissions occurred during the initial site development. High-density developments utilize a smaller footprint per housing unit, and therefore can reduce GHG emissions associated with their construction [48]. This focus on high-density development, combined with building on low-carbon soils, greyfield and/or brownfield redevelopment could further limit overall development pressure on existing soils. This would leave land areas available for carbon sequestration through urban forestry.

5. Conclusions

Conflicts of interest can be viewed as an intersection of different perspectives on land use (e.g., conservation versus development). Land conservation often leads to C sequestration in contrast to land development, which can result in C losses. This case study used the state of NJ to examine the social costs of emissions in soils associated with developments. The magnitude of these social costs of carbon dioxide (CO_2) emissions is limited by the pedodiversity of NJ, which defines the soil C content and the value of regulating ES/ED from soil organic carbon (SOC), soil inorganic carbon (SIC), and total soil carbon (TSC) stocks. Currently, NJ's GHG inventory does not include soil as a source of GHG emissions, which may be caused by COIs. Our study is innovative because it provides a method to add monetary value to GHG emissions from land conversion which makes the COI no longer an abstract concept but can be included in a quantifiable cost-benefit analysis.

Although firm action against climate change would benefit both NJ and the world, progress is slow because of COI. Conflicts of interest pervade the climate-change debate—among politicians, academics, and many others—hindering progress, or even blocking it completely. Our study reveals one particular COI, but also provides the means for reducing the COI's impact. We measure the environmental harms that development causes through soil disturbance and the resulting release of GHGs. This creates a COI for policymakers: between their desire to promote the state's long-term interests by controlling climate change by limiting development, and their desire to promote development so as to improve short-term economic conditions and increase their probability of reelection. Policymakers may choose to sacrifice the state's long-term interests to the policymakers' self-interest in being reelected.

However, our study may help to limit this COI's impact by providing clear information about development's environmental costs. Ideally, policymakers should impose development fees that reflect these costs. However, COIs may deter policymakers from establishing these fees; the fees may deter development, reduce economic activity and the number of jobs, anger developers, and so decrease the policymakers' prospects for reelection.

Our results are generalizable to other countries and economies. Every political entity faces the same conflict between the need to control GHG emissions from soil disturbance and the need to further other goals such as development, employment, and politicians' electability. However, the United States and other wealthy countries may present the greatest possibility of conquering these conflicts; less-wealthy countries may find it even more difficult to sacrifice even current prosperity for inchoate environmental benefits that will occur long in the future.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/geographies2040041/s1, Table S1: Midpoint soil organic carbon (SOC) storage by soil order and county for the state of New Jersey (USA); Table S2: Midpoint soil inorganic carbon (SIC) storage by soil order and county for the state of New Jersey (USA); Table S3: Midpoint total soil carbon (TSC) storage by soil order and county for the state of New Jersey (USA).

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Glossary

CF	Carbon footprint
ED	Ecosystem disservices
ES	Ecosystem services
EPA	Environmental Protection Agency
SC-CO_2	Social cost of carbon emissions
SDGs	Sustainable Development Goals
SOC	Soil organic carbon
SIC	Soil inorganic carbon
SOM	Soil organic matter
SSURGO	Soil Survey Geographic Database
STATSGO	State Soil Geographic Database
TSC	Total soil carbon
USDA	United States Department of Agriculture

References

1. EPA—United States Environmental Protection Agency, The Social Cost of Carbon. EPA Fact Sheet. 2016. Available online: https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html (accessed on 15 September 2021).
2. New Jersey Statutes Annotated 26:2C-37. Global Warming Response Act. 2007. Available online: https://www.nj.gov/dep/aqes/docs/gw-responseact-07.pdf (accessed on 18 April 2022).
3. New Jersey Executive Order No. 274. Available online: https://nj.gov/infobank/eo/056murphy/pdf/EO-274.pdf (accessed on 18 April 2022).
4. Georgetown Climate Center. A Leading Resource for State and Federal Policy. 2022. Available online: https://www.georgetownclimate.org/adaptation/plans.html (accessed on 18 April 2022).
5. United Nations. Paris Agreement. 2015. Available online: https://unfccc.int/sites/default/files/english_paris_agreement.pdf (accessed on 1 September 2021).
6. Keestra, S.D.; Bouma, J.; Wallinga, J.; Tittonell, P.; Smith, P.; Cerdà, A.; Montanarella, L.; Quinton, J.N.; Pachepsky, Y.; Van der Putten, W.H.; et al. The significance of soils and soil science towards realization of the United Nations Sustainable Development Goals. *Soil* **2016**, *2*, 111–128. [CrossRef]
7. New Jersey Department of Environmental Protection. *2018 Statewide Greenhouse Gas Emissions Inventory*; New Jersey Department of Environmental Protection: Trenton, NJ, USA, 2019; pp. 1–21.
8. Hill, R.; Rutkowski, M.M.; Lester, L.A.; Genievich, H.; Procopio, N.A. (Eds.) *New Jersey Scientific Report on Climate Change, Version 1.0*; New Jersey Department of Environmental Protection: Trenton, NJ, USA, 2020; p. 184.
9. Mikhailova, E.A.; Groshans, G.R.; Post, C.J.; Schlautman, M.A.; Post, C.J. Valuation of total soil carbon stocks in the contiguous United States based on the avoided social cost of carbon emissions. *Resources* **2019**, *8*, 157. [CrossRef]
10. Natural Resources Conservation Service. n.d. USDA. Downer—New Jersey State Soil. Available online: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1236981.pdf (accessed on 18 April 2022).
11. Mikhailova, E.A.; Zurqani, H.A.; Post, C.J.; Schlautman, M.A.; Post, C.J. Soil diversity (pedodiversity) and ecosystem services. *Land* **2021**, *10*, 288. [CrossRef]
12. Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. n.d.a. Soil Survey Geographic (SSURGO) Database. Available online: https://nrcs.app.box.com/v/soils (accessed on 10 September 2021).
13. The United States Census Bureau, TIGER/Line Boundary Shapefiles. 2018. Available online: https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.2018.html (accessed on 10 September 2021).
14. U.S. Bureau of the Census. *Statistical Abstract of the United States: 1991*; U.S. Bureau of the Census: Washington, DC, USA, 1991; p. 201. Available online: https://www.census.gov/library/publications/1991/compendia/statab/111ed.html (accessed on 10 December 2021).
15. Hasse, J.E.; Lathrop, R.G. *Measuring Urban Growth in New Jersey. A Report on Recent Land Development Patterns Utilizing the 1986-1995 NJ DEP Land Use/Land Cover Dataset*; Rutgers University: New Brunswick, NJ, USA, 2001.
16. Scharlemann, J.P.W.; Tanner, E.V.J.; Hiederer, R.; Kapos, V. Global soil carbon: Understanding and managing the largest terrestrial carbon pool. *Carbon Manag.* **2014**, *5*, 81–91. [CrossRef]
17. Sanderman, J.; Hengl, T.; Fiske, G. Soil carbon debt of 12,000 years of human land use. *Proc. Natl. Acad. Sci. USA* **2017**, *114*, 9575–9580. [CrossRef] [PubMed]

18. Lal, R. Societal value of soil carbon. *J. Soil Water Conserv.* **2014**, *69*, 186A–192A. [CrossRef]
19. Roulet, N.T. Peatlands, carbon storage, greenhouse gases, and the Kyoto Protocol: Prospects and significance for Canada. *Wetlands* **2000**, *20*, 605–615. [CrossRef]
20. Guo, Y.; Amundson, R.; Gong, P.; Yu, Q. Quantity and spatial variability of soil carbon in the conterminous United States. *Soil Sci. Soc. Am. J.* **2006**, *70*, 590–600. [CrossRef]
21. Multi-Resolution Land Characteristics Consortium—MRLC. Available online: https://www.mrlc.gov/ (accessed on 1 September 2021).
22. Groshans, G.R.; Mikhailova, E.A.; Post, C.J.; Schlautman, M.A.; Zhang, L. Determining the value of soil inorganic carbon stocks in the contiguous United States based on the avoided social cost of carbon emissions. *Resources* **2019**, *8*, 119. [CrossRef]
23. ESRI—Environmental Systems Research Institute. ArcGIS Pro 2.6. Available online: https://pro.arcgis.com/en/pro-app/2.6/get-started/whats-new-in-arcgis-pro.htm (accessed on 1 September 2021).
24. Mikhailova, E.A.; Groshans, G.R.; Post, C.J.; Schlautman, M.A.; Post, G.C. Valuation of soil organic carbon stocks in the contiguous United States based on the avoided social cost of carbon emissions. *Resources* **2019**, *8*, 153. [CrossRef]
25. Ngoy, K.I.; Feng, Q.; Shebitz, D.J. Analyzing and predicting land use and land cover changes in New Jersey using multi-layer Perceptron-Markon chain model. *Earth* **2021**, *2*, 50. [CrossRef]
26. Johnson, B.N.J. Environmentalists Go to Court to Force Murphy Administration to Adopt Climate Change Standards. Available online: https://www.nj.com/politics/2022/01/nj-environmentalists-go-to-court-to-force-murphy-administration-to-adopt-climate-change-standards.html (accessed on 10 June 2022).
27. Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Photos of Soil Orders. Available online: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_053588 (accessed on 20 September 2021).
28. Bernardini, M. Rising seas could destroy millions of U.S. acres in decades. *U.S. News*, 8 September 2022. Available online: https://www.upi.com/Top_News/US/2022/09/08/Climate-Central-Maryland-Louisiana-North-Carolina-Texas/7951662676232/ (accessed on 13 September 2022).
29. Fausset, R. Beach Houses on the Outer Banks Are Being Swallowed by the Sea. (14 May 2022). Available online: https://www.nytimes.com/2022/05/14/us/outer-banks-beach-houses-collapse.html (accessed on 1 June 2022).
30. Watson, M.; Cullinane, S. Wildfire in Southern New Jersey grows to about 12,000 Acres. Available online: https://www.cnn.com/2022/06/20/weather/new-jersey-wildfire-wharton-state-forest/index.html (accessed on 10 June 2022).
31. National Oceanic and Atmospheric Administration (NOAA). Available online: https://www.climate.gov/maps-data (accessed on 2 October 2022).
32. Bion, J.; Antonelli, M.; Blanch, L.; Curtis, J.R.; Druml, C.; Du, B.; Machado, F.R.; Gomersall, C.; Hartog, C.; Levy, M. White paper: Statement on conflicts of interest. *Intensive Care Med.* **2018**, *44*, 1657–1668. [CrossRef] [PubMed]
33. Bion, J.; Bellomo, R.; Finfer, S.; Myburgh, J.; Perner, A.; Reinhart, K. Comments: Response to correspondence from Van Aken and colleagues, and from Priebe, concerning our Open letter to the Executive Director of the European Medicines Agency concerning the licensing of hydroxyethyl starch solutions for fluid resuscitation. *Br. J. Anaesth.* **2014**, *112*, 595–600.
34. Flavelle, C.; Tate, J. How Joe Manchin Aided Coal, and Earned Millions. Available online: https://www.nytimes.com/2022/03/27/climate/manchin-coal-climate-conflicts.html (accessed on 10 June 2022).
35. Sneath, S. Louisiana Legislator Pushes Bills Benefiting the Oil and Gas Industry—And Her Husband. Available online: https://www.theguardian.com/environment/2022/may/06/sharon-hewitt-louisiana-senator-oil-gas-industry?CMP=oth_b-aplnews_d-1 (accessed on 10 June 2022).
36. Vetter, D. "Who Cares If Miami Is 6 Meters Underwater In 100 Years?": HSBC Executive's Incendiary Climate Comments. Available online: https://www.forbes.com/sites/davidrvetter/2022/05/20/who-cares-if-miami-is-6-meters-underwater-in-100-years-hsbc-executives-incendiary-climate-comments/?sh=4b51e4ab590a (accessed on 10 June 2022).
37. Meltz, R. Climate Change and Existing Law: A Survey of Legal Issues Past, Present, and Future. Available online: https://sgp.fas.org/crs/misc/R42613.pdf (accessed on 10 June 2022).
38. Dietz, T. Political events and public views on climate change. *Clim. Chang.* **2020**, *161*, 1–8. [CrossRef] [PubMed]
39. McCright, A.M.; Marquart-Pyatt, S.T.; Shwom, R.L.; Brechin, S.R.; Allen, S. Ideology, capitalism, and climate explaining public views about climate change in the United States. *Energy Res. Soc. Sci.* **2016**, *21*, 180–189. [CrossRef]
40. Tollefson, J. Earth science wrestles with conflict-of-interest policies. *Nature* **2015**, *522*, 403–404. [CrossRef] [PubMed]
41. Stecula, D.A.; Merkley, E. Framing climate change: Economics, ideology, and uncertainty in American news media content from 1988 to 2014. *Front. Commun.* **2019**, *4*, 6. [CrossRef]
42. Basseches, J.A.; Bromley-Trujilli, R.; Boykoff, M.T.; Culhane, T.; Hall, G.; Healy, N.; Hess, D.J.; Hsu, D.; Krause, R.M.; Prechel, H. Climate policy confict in the U.S. states: A critical review and way forward. *Clim. Chang.* **2022**, *170*, 32. [CrossRef] [PubMed]
43. Transparency International. Conflicts of Interest and Undue Influence in Climate Action: Putting a Stop to Corporate Efforts undermining Climate Policy and Decisions. Available online: https://images.transparencycdn.org/images/2021_ConflictsOfInterestClimateAction_PolicyBrief_EN.pdf (accessed on 9 October 2022).
44. Weible, C.M.; Heikkila, T. Policy conflict framework. *Policy Sci.* **2017**, *50*, 23–40. [CrossRef]
45. Doelle, M.; Seck, S. Loss and damage from climate change: from concept to remedy? *Clim. Policy* **2019**, *20*, 1–12.

46. Strauss, B.H.; Orton, P.M.; Bitterman, K.; Buchanan, M.K.; Gilford, D.M.; Kopp, R.E.; Kulp, S.; Massey, C.; de Moel, H.; Vinogradov, S. Economic damages from Hurricane Sandy attributable to sea level rise caused by anthropogenic climate change. *Nat. Commun*. **2021**, *12*, 1–9. https://doi.org/10.1038/s41467-021-22838-1.
47. Brown, S.; Miltner, E.; Cogger, C. Carbon Sequestration Potential in Urban Soils. In *Carbon Sequestration in Urban Ecosystems*; Springer: Dordrecht, The Netherlands, 2012; pp. 173–196.
48. Andrews, C.J. Greenhouse gas emissions along the rural-urban gradient. *J. Environ. Plan. Manag*. **2008**, *51*, 847–870.