The Socioeconomic Impacts of Sea Level Rise and *Phragmites australis* in the New Jersey Meadowlands

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ABSTRACT

Sea level rise is one of the most alarming impacts of climate change and is projected to have devastating economic consequences for coastal communities such as increased flood damage, lost economic productivity, and decreased property values. To measure this impact in the New Jersey Meadowlands, an urban estuary ecosystem, I used a digital elevation model (DEM) to create inundation maps modeling 1, 2, and 3 ft of SLR. The DEM was combined with real estate and land use maps to assess the value of properties impacted by SLR and to identify the impacted economic sectors. Our nearest neighbor analysis revealed a negative correlation between the distance of properties of the nearest waterbody and their sale prices. Our modeling efforts indicate that the Meadowlands area will be greatly impacted by inundation from SLR with projected at-risk real-estate ranging between $1.7 – 4.3 billion between the years 2050 and 2130. Additionally, as sea levels rise, the proportion of commercial, industrial, and residential areas affected increases relative to the proportion of forests, wetlands, and open areas affected. These insights point to the severity of potential SLR impacts on the New Jersey coastal economy. It is crucial that decision-makers in the Meadowlands and beyond integrate climate change impacts, particularly SLR, into development and infrastructure planning to avoid these severe economic consequences.

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INTRODUCTION

According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, in 2019, the atmospheric concentrations of carbon dioxide were higher than at any time in the past 2 million years, causing warming of 1.1°C above 1850–1900 levels (Calvin et al., 2023; Gillett et al., 2021). This is a key driver of climate change, which refers to a lasting statistically significant variation in the climate's mean state or variability.

Among the most alarming impacts of climate change is sea level rise. As a result of rapid Arctic and Antarctic warming, substantial amounts of land-based ice melt and flow into the ocean (Arctic Monitoring and Assessment Programme, 2021). Sustained warming levels at or slightly above 1.5–2.0 °C will trigger irreversible melting of both the Greenland and West Antarctic sheets over the next multiple millennia. (Pattyn et al., 2018). Even if temperatures stabilize under a low emissions scenario, sea levels are projected to continue rising because of thermal expansion (Meehl et al., 2012). SLR can inundate properties, push storm surge flooding inland, and dramatically alter and erode coastal ecosystems, compressing coastal wetlands in a process called coastal squeeze. Coastal wetlands are particularly at risk because of the ongoing extirpation of native species, sea level inundation, and saltwater intrusion. Furthermore, sustained SLR will cause increased coastal wetland fragmentation, giving more opportunity for invasive, fast-reproducing marsh plant species to spread (Marvier et al., 2004).

The socioeconomic consequences of sea level rise are already evident across various regions of the United States. For example, in the Mississippi River Delta, stressors including SLR contribute to high rates of coastal land loss of up to 100 km^2 per year (Elsey-Quirk et al., 2024). In addition, the Miami-Dade area has experienced increased rain and tide-induced flooding and a loss of $465 million in real-estate market value between 2005 and 2016 (McAlpine & Porter, 2018).

An ecosystem that may soon be impacted by SLR is the New Jersey Meadowlands. The New Jersey Meadowlands is a rich coastal wetland ecosystem within 3 miles of Manhattan (Marshall, 2004). According to the New Jersey Scientific Report on Climate Change, SLR in this area alone has been projected to reach 3.3 ft by 2100 which will eventually impact multiple highways and railways leading to New York City, the urban towns surrounding the ecosystem, and the 34 km^2 of remaining wetland (New Jersey Department of Environmental Protection, 2020). The New Jersey Meadowlands has been dominated by an invasive plant species known as *Phragmites australis*. *Phragmites* has a worse stress response to high salinity conditions, which may affect its spread, but not to the extent salinity affects other marsh species (Lynn & Elsey-Quirk, 2024). It is not known to what extent SLR and *Phragmites* reliance are correlated, but both factors will invariably influence the fate of the Meadowlands ecosystem.

The socioeconomic impacts of climate change on societies remain uncertain due to the multitude of factors that must be considered such as the unpredictability of extreme weather events and varying regional vulnerabilities. However, some studies have specifically focused on the real estate and coastal impacts of SLR (Bin et al., 2011; Lichter & Felsenstein, 2011; Fu et al., 2016) whereas others have focused on impacts on different business sectors such as tourism (Song et al., 2016; Stafford & Renaud, 2019; Bigano et al., 2008). Studies focusing on real estate often employed spatial hedonic models, a type of hedonic house price model that explicitly considers the locational aspects of the observations (Anselin & Lozano-Grazia, 2009). Hedonic pricing breaks down a marketed good into its individual attributes and observe how much they attribute. These studies were observed to concentrate on a local level. Though not as severe as inundation, sea level rise-induced isolation can also cause significant devaluation of properties and loss in economic productivity for businesses.

This article models the inundation of the Meadowlands area in different warming scenarios and estimates the socioeconomic impact by calculating the property values of areas affected by inundation. Our results aim to help policymakers and homeowners understand the socioeconomic impacts of sea level rise and to plan accordingly.

LITERATURE REVIEW

Sea Level Rise in the Meadowlands

The New Jersey Meadowlands is a rich coastal wetland ecosystem within 5 km of Manhattan with roughly 8300 hectares (83 km^2) of wetlands and developed land (Marshall, 2004). In recent years, human use and alteration have considerably impacted biodiversity in the Meadowlands. Decades of illegal dumping and extensive physical development have shrunk the original 42 square miles of wetland by 69%, leaving only 13 square miles remaining. (Marshall, 2004). The Meadowlands, in particular, serve as a model system to study SLR because of what is at risk: the multiple highways and railways leading to New York City, the urban towns surrounding the ecosystem, and the miles of remaining coastal wetland. The Meadowlands area also represents a busy transportation hub for the Northeast with significant rail (Amtrak and NJ Transit), air travel (Teterboro Airport), and road (NJ Turnpike and Interstate Highways 80 and 280) facilities located throughout.

Further, many species of birds, fish, plants, insects, etc. depend on the Meadowlands as their habitat. More than 260 species of birds were identified in the Meadowlands, 33 of which are state listed as endangered, threatened, or declining (Kiviat & MacDonald, 2004).

Recent studies have estimated a sea level rise of approximately 3.3 feet by 2100, along with surface elevation changes in the Meadowlands, showing an increase of 4.0 ± 0.7 mm per year. Artigas et al. (2021) investigated SLR specific to the Meadowlands and used the rod surface elevation table, a mechanical leveling device with screwed together rods that drive down into wetland soil, to measure changes in wetland surface elevation between 2008 and 2019. They concluded a subsidence rate of 1.5 ± 1.3 mm/year and increases in surface elevation of 4.0 ± 0.7 mm/year. Artigas et al. (2021) utilized the SLR rate of a 50% chance of

8 mm/year by the year 2050 derived from a study by Kopp et al. (2016). The 2020 New Jersey Scientific Report on Climate Change included an estimate for SLR in New Jersey using projections of 19-year averages based on Kopp et al. (2014), Rasmussen et al. (2018), and Bamber et al. (2019). All studies used a multi-model system. The report found that by 2100, there is a 50% chance that SLR will meet or exceed 3.3 feet under a moderate emission scenario. The report also included elevation gain in the Meadowlands that was estimated in 2015 from the same research institute as Artigas et al. (2021), yielding results of 0.16 in/yr and 0.23 in/yr (3.18 and 5.84 mm/year).

Under RCP4.5, a moderate scenario in which emissions peak around 2040 and then decline, Kopp et al. (2017) used DeConto & Pollard (2016) projections and utilized projections based on new physical modeling to estimate SLR. This study suggested that by 2100 there will be around 0.91 meters or 2.99 feet of SLR. The New York City Panel on Climate Change utilized 24 global climate models and found similar figures on SLR of approximately 3 feet by 2100 by taking the mean of the middle range (25–75th percentile) of SLR by 2100 of 1.83 -- 4.17 ft. Reviewed studies were mainly focused on determining the upper and lower extremes of SLR using RCP scenarios and utilized multi-model systems to obtain results. Field instruments were only utilized in Artigas et al. (2021), which was the only study specifically studying the Meadowlands.

Interaction between Sea Level Rise and *Phragmites australis*

The Meadowlands, like many other coastal wetlands along the East and Gulf coast in the United States, is dominated by the invasive common reed (*Phragmites australis*) (Kiviat & MacDonald, 2004). *Phragmites* are the most common plant in the Meadowlands where they are mixed with *Spartina patens* and other marsh plants (Artigas et al., 2021). They are invasive, resistant to ecological change, and reduce biodiversity by out-competing native species (Saltonstall, 2002; Windham and Meyerson, 2003).

Whether or not to focus on eliminating this plant in wetland restoration projects has been the subject of debate in recent years. While many studies agree that *Phragmites* should be removed because they vigorously outcompete native species and harm wildlife that depend on a diverse habitat, some studies show that *Phragmites* can also maintain vegetative cover in wetlands, functioning as effective carbon sinks and protecting against erosion (Rooth & Stevenson, 2000). There is also little information on the impact of removing *Phragmites* on the ecosystem (Hazelton et al., 2014; Bonello & Judd, 2019) and if those methods are effective and worth the cost of removal (Gilson, 2017; Martin & Blossey, 2013).

When Meadowlands conditions change because of the rise in sea level, two main threats face marsh plants: flooding and increased salinity. Saltwater is pushed further inland when storm intensity and frequency increase. Though *Phragmites* are considered salt-tolerant and resilient in general, flooding for more than 19% of the time resulted in lower survival rates of *Phragmites* (Lynn & Elsey-Quirk, 2024). *Phragmites* in salt marshes are more vulnerable to flooding than *Phragmites* located in low-salinity marshes (Lynn & Elsey-Quirk, 2024). *Phragmites* in the Meadowlands predominantly reside in brackish marshes. *Phragmites'* main competitor in low marshes in the Meadowlands, *Spartina alterniflora*, may expand instead because of its higher tolerance to salinity and sulfide. For the Meadowlands, this means a potential increase in biodiversity since *Spartina* is a nursery ground and a better food source for more animal species.

Socioeconomic Impacts of Sea Level Rise

The New York New Jersey Metropolitan Area is currently susceptible to the widespread effects of sea level rise. During Hurricane Sandy, the area suffered over $60 billion in damages due to inundation, isolation of real estate, and alterations to ecosystems (Moel et al., 2013),. SLR can have significant socioeconomic impacts, especially in the case of coastal wetlands like the New Jersey Meadowlands, a popular recreation area surrounded by urban infrastructure and winding roads. The rising sea level will affect the Meadowlands' appeal as a popular recreational and tourist destination. Without tourism, every household in the Meadowlands Liberty Region would have to contribute an additional $968 annually to maintain the current level of government services (Tourism Economics, 2018). The Meadowlands also contains valuable real estate worth hundreds of billions combined including recreational and industrial properties like the American Dream Mall and the MetLife Stadium. If SLR were to cause devaluation, inundation, or isolation of these properties, the economic consequences would be severe.

To quantify these socioeconomic impacts, past research had mainly two focuses: the quantitative results of real estate property or other losses to SLR (Bin et al., 2011; Lichter & Felsenstein, 2011; Fu et al., 2016), while other papers specifically looked at businesses and sector-wide impacts (Song et al., 2016; Stafford & Renaud, 2019; Bigano et al., 2008). The research that focused on real estate often applied a spatial hedonic approach on a local level (Beck & Lin, 2021; Bin et al., 2011; Lichter & Felsenstein, 2011; Fu et al., 2016). Many studies also investigated the relationship between proximity to waterfronts and real estate prices to eliminate this premium from their results since it will presumably be transferred to new properties at the waterfront. Research on sector-wide impacts focused on producing frameworks and broader economic predictions like the effect on GDP using computable general equilibrium models (Parrado et al., 2020; Bigano et al., 2008; Bosello et al., 2011). These studies usually investigated a larger area than studies on real estate.

Recent research looked at another underlying impact of SLR, the isolation of properties from surrounding infrastructure due to increased flooding, which has major consequences on real estate prices and businesses in the area that cannot open or receive customers while isolated (Logan et al., 2023). According to Best et al., (2023), it is estimated that 34 counties face a disproportionate risk of isolation for both Black and Hispanic populations at 3 ft of SLR, and there are six such counties in New Jersey alone.

METHODS

By applying predictions from previous studies to QGIS analysis, I aim to predict how sea level rise impacts property values in the Meadowlands community. I used subsidence rates from previous studies to estimate the inundation impacts of SLR in the Meadowlands. Artigas et al., (2021) concluded with estimates of 4.0 ± 0.7 mm/year overall increase in surface elevation in the Meadowlands regardless of SLR, which means approximately 1.0 ± 0.2 feet of increase in surface elevation from 2020 to 2100. While SLR estimates differed slightly across sources, they were all relatively close to 3 feet. 3.3 feet of SLR by 2100 was obtained by using the most recent 2020 New Jersey Scientific Report on Climate Change. The increase in surface elevation was subtracted from SLR to obtain an estimate of 2.3 feet for the relative SLR in the Meadowlands in 2100. This would mean an average of 8.8 mm/year of relative SLR until 2100.

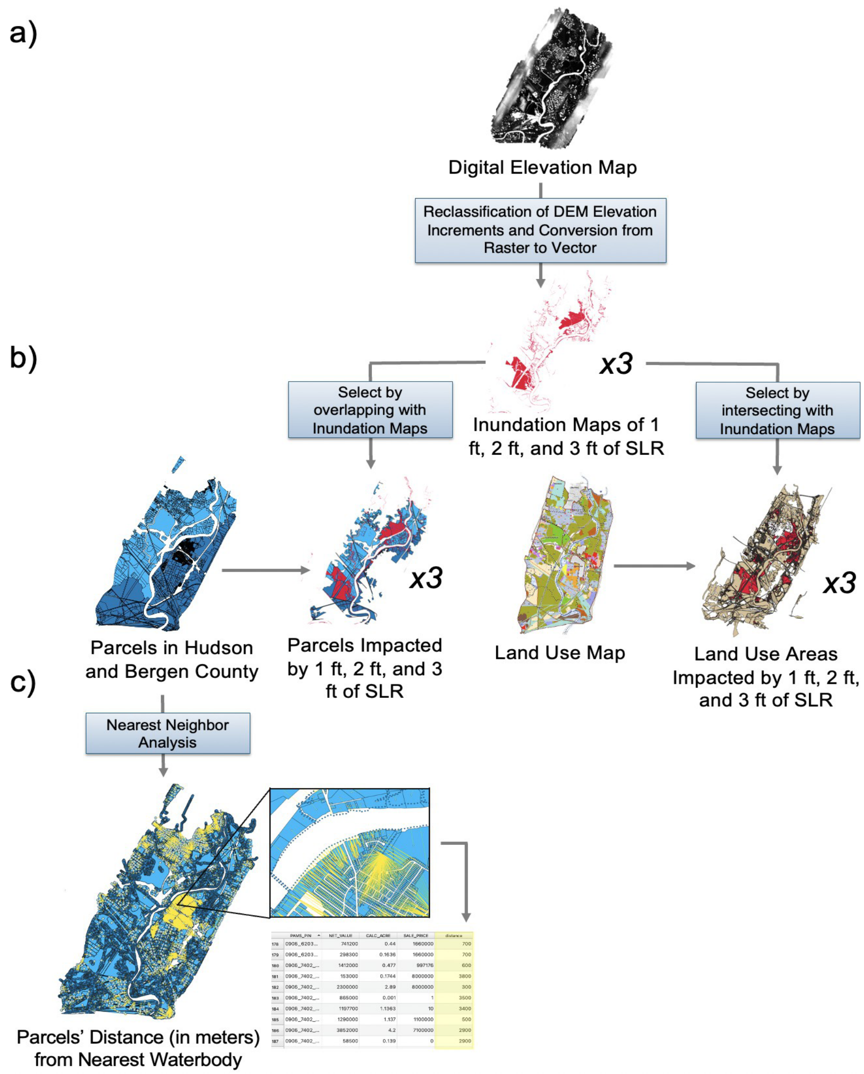


Figure 1: (a) DEM from NOAA calibrated to create inundation maps of 1, 2, and 3 ft of SLR (b) inundation maps overlapped with parcel and land use data to select areas impacted by SLR (c) a nearest neighbor analysis to obtain each parcel's distance from nearest waterbody.

LiDAR (light detection and ranging) elevation data of the Meadowlands area from 2014 from the National Oceanic Atmospheric Administration (NOAA) was used to create inundation maps of the Meadowlands area in QGIS (Quantum Geographic Information System). Three inundation maps of SLR at 1, 2, or 3 feet were developed through setting layers at 1ft, 2ft, and 3ft above water level to quantify the impacts of inundation (Figure 1a). The SLR values were chosen based on predictions of SLR inundation for the Meadowlands area (Artigas et al., 2021; New Jersey Scientific Report on Climate Change, 2020).

The three inundation maps were converted to shapefiles and then overlaid with municipal tax lot datasets of Bergen and Hudson counties from the New Jersey Office of GIS (Parcel and MOD IV Figure 1b). This study used the May 2024 update of the dataset for Hudson County and the November 2023 update for Bergen County. I summed the sale prices of parcels flooded under each SLR scenario. I chose sale price because previous analysis focused on prices for which the property was last sold, and it is the best estimation for real estate value from the dataset (Bernstein et al., 2018). I used a 2% discount rate consistent with federal practice (Office of Management and Budget, 2023).

I calculated the shortest distance between waterbodies and the centroids of parcels using shapefiles of waterbodies in the Meadowlands in QGIS (Figure 1c). That distance, in meters, was then used to see whether proximity to water bodies was correlated with real-estate premiums. Then, scatter plots were constructed to investigate the relationship between distance from waterbodies and the sale price of parcels in each county.

I also determined which land uses were most likely to be affected by sea level rise. Land Use data from the NJ Department of Environmental Protection from 2020 was imported into QGIS. Three SLR inundation maps were overlaid over divided parcels from the land use data, and the parcels that overlapped with each of the three inundation maps were extracted along with each parcel's land use data. Then, the area of overlap between the inundation map and extracted parcels was recorded through an overlay analysis. I grouped together the initial 40+ land use categories to make 8 categories (Water Bodies and Wetlands, Transportation, Recreational and Specialized areas, Forests and Shrubs, Commercial and Industrial areas, Residential Areas, Open and Transitional Areas, and *Phragmites*) (Table 1). I summed the area inundated in parcels of each category to gather data on which categories are most heavily impacted.

Water Bodies and Wetlands	Artificial Lakes, Deciduous Scrub/Shrub Wetlands, Deciduous Wooded Wetlands, Disturbed Tidal Wetlands, Disturbed Wetlands (Modified), Herbaceous Wetlands, Managed Wetland In Built-Up Maintained Rec Area, Managed Wetland In Maintained Lawn Greenspace, Mixed Scrub/Shrub Wetlands (Deciduous Dom.), Natural Lakes, Saline Marsh (High Marsh), Saline Marsh (Low Marsh), Streams And Canals, Tidal Mud Flat, Tidal Rivers, Inland Bays, And Other Tidal Waters
Phragmites	Phragmites Dominate Coastal Wetlands, Phragmites Dominate Interior Wetlands, Phragmites Dominate Old Field, Phragmites Dominate Urban Area
Forests and Shrubs	Deciduous Brush/Shrubland, Deciduous Forest (>50% Crown Closure), Deciduous Forest (10-50% Crown Closure), Mixed Deciduous/Coniferous Brush/Shrubland

Open and Transition Areas	Transitional Areas, Stormwater Basin, Old Field (< 25% Brush Covered), Altered Lands
Transportation	Transportation/Communication/Utilities, Upland Rights-Of-Way Developed, Upland Rights-Of-Way Undeveloped, Wetland Rights-Of-Way, Railroads, Airport Facilities, Bridge Over Water, Major Roadway, Mixed Transportation Corridor Overlap Area
Commercial and Industrial areas	Commercial/Services, Industrial, Industrial And Commercial Complexes, Other Urban Or Built-Up Land
Recreational and Specialized areas	Athletic Fields (Schools), Cemetery, Cemetery On Wetland, Recreational Land, Stadium, Theaters, Cultural Centers And Zoos
Residential Areas	Residential, High Density Or Multiple Dwelling, Residential, Rural, Single Unit, Residential, Single Unit, Low Density, Residential, Single Unit, Medium Density

Table 1: Classification of the given 49 land use categories from the 2020 Land Use data from the NJ Department of Environmental Protection into 8 categories for easier visualization.

RESULTS & DISCUSSION

For Bergen County, a total of 1,684 parcels in the Meadowlands area were used in the analysis from the 299,745 total parcels (worth collectively $124 billion). Depending on the SLR scenarios, the number of residential properties at risk of inundation ranges between 295 in the case of 1 ft inundation (projected in 2050) and 760 in the case of 3 ft inundation (projected in 2130) (Figure 2). Without discounting, the residential property value loss in Bergen County ranges from $1.26 billion (1.02 percent of the total assessed value) to $2.33 billion (1.88 percent of the total assessed value). Based on the 2 percent discount rate, the estimated loss ranges from $436 million (0.35 percent) to $183 million (0.15 percent).

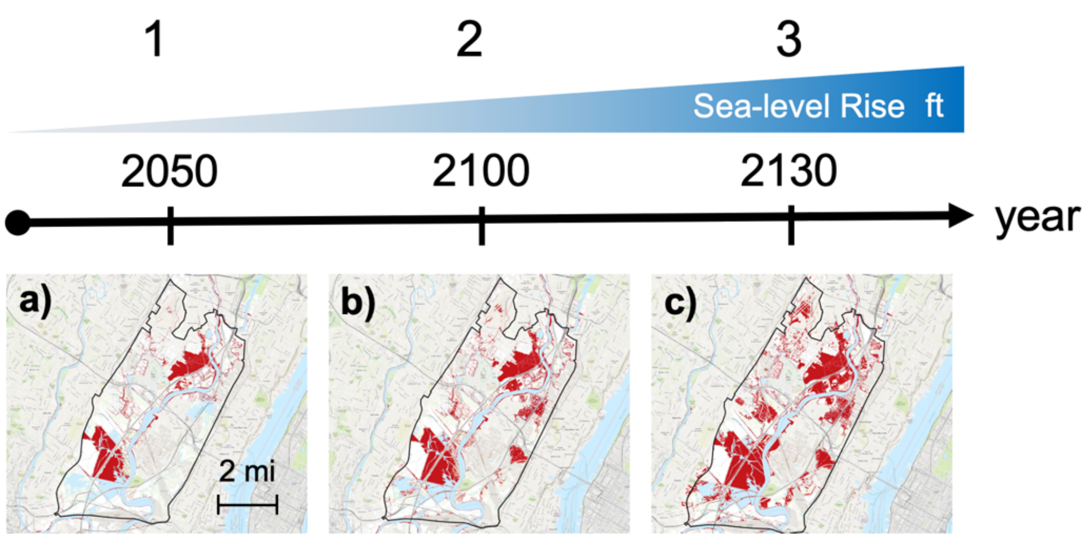


Figure 2: Inundation maps showcasing impacted areas at 1, 2, and 3 feet of SLR in the Meadowlands developed on QGIS. Years based on relative SLR predictions based on Artigas et al. (2021) and the 2020 New Jersey Scientific Report on Climate Change

For Hudson County, a total of 6,341 parcels in the Meadowlands area were used from the 146,437 total parcels (worth collectively $90 billion). Depending on the SLR scenarios, the number of residential properties at risk of inundation ranges between 270 (2050) and 936 (2130) (Figure 2). Without discounting, the residential property value loss in Hudson County ranges from $454 million (0.5 percent of the total assessed value) to $1.99 billion (2.21 percent of the total assessed value). Based on the 2 percent discount rate, the estimated loss ranges from $223 million (0.25 percent) to $362 million (0.4 percent).

There is a significant increase in inundation across all land types, however, increases in inundation are not uniform across increments. As sea level increases, the percent change of commercial, industrial, and residential areas affected shows a greater increase across all inundation scenarios (1, 2, 3 ft) than ecological areas (Table 2). In terms of commercial and industrial areas affected, the breakdown is a 1308% increase in area affected from 54 thousand m^2 at 1 ft to 765 thousand m^2 at 3 ft of SLR (Table 2). Residential areas experienced the most significant increase in area of land affected from 1 foot to 3 feet of SLR of 1579% increase from ~5 to 89 thousand m^2 (Table 2). Nevertheless, residential areas have a relatively low area affected compared to other categories (Figure 3).

Wetlands, waterbodies, and *Phragmites* regions remain over 90% of all inundated regions under all three scenarios (Figure 3b, 3d, 3f). However, their percentage increase in area inundated from 1 ft to 3 ft of SLR decreases and is among the lowest (Table 2). For the Meadowlands, this would potentially mean a more diverse habitat but less overall vegetative cover and more erosion. Natural dieback from SLR could serve as a cost-free way of removing *Phragmites* from ecosystems, though other plants will be affected as well. Meadowlands authority might shift the priority of future restoration missions from removing *Phragmites* elsewhere. Over 60,000 m^2 of transportation infrastructure could be inundated by 1 foot of SLR, showing how SLR could add to existing problems with commuting, especially to New York City (Table 2). This includes airport facilities, major roadways, railroads, bridges over water, etc.

	Water Bodies and Wetlands	Transportation	Recreational and Sepecialized Areas	Forests and Shrubs	Commercial and Industrial Areas	Residential Areas	Open and Transitional Areas	Phragmites
1 ft inundation (m^2)	6,514,651	68,392	11,468	38,159	54,401	5,287	18,438	18,438
1 ft→2 ft (% increase)	30%	155%	89%	151%	287%	256%	236%	108%
2 ft inundation (m^2)	8,492,476	174,358	21,662	95,594	210,381	18,811	61,959	3,109,763
2 ft→3 ft (% increase)	15%	110%	143%	117%	264%	372%	167%	96%
3 ft inundation (m^2)	9,791,327	366,913	52,721	207,873	765,893	88,775	165,587	6,090,921
1 ft→3 ft (% increase)	50%	436%	360%	445%	1308%	1579%	798%	307%

Table 2: Table comparing 8 land use categories that inundated areas fall under in m^2, and shows the percentage increase in each category from 1 ft to 2 ft to 3 ft of SLR.

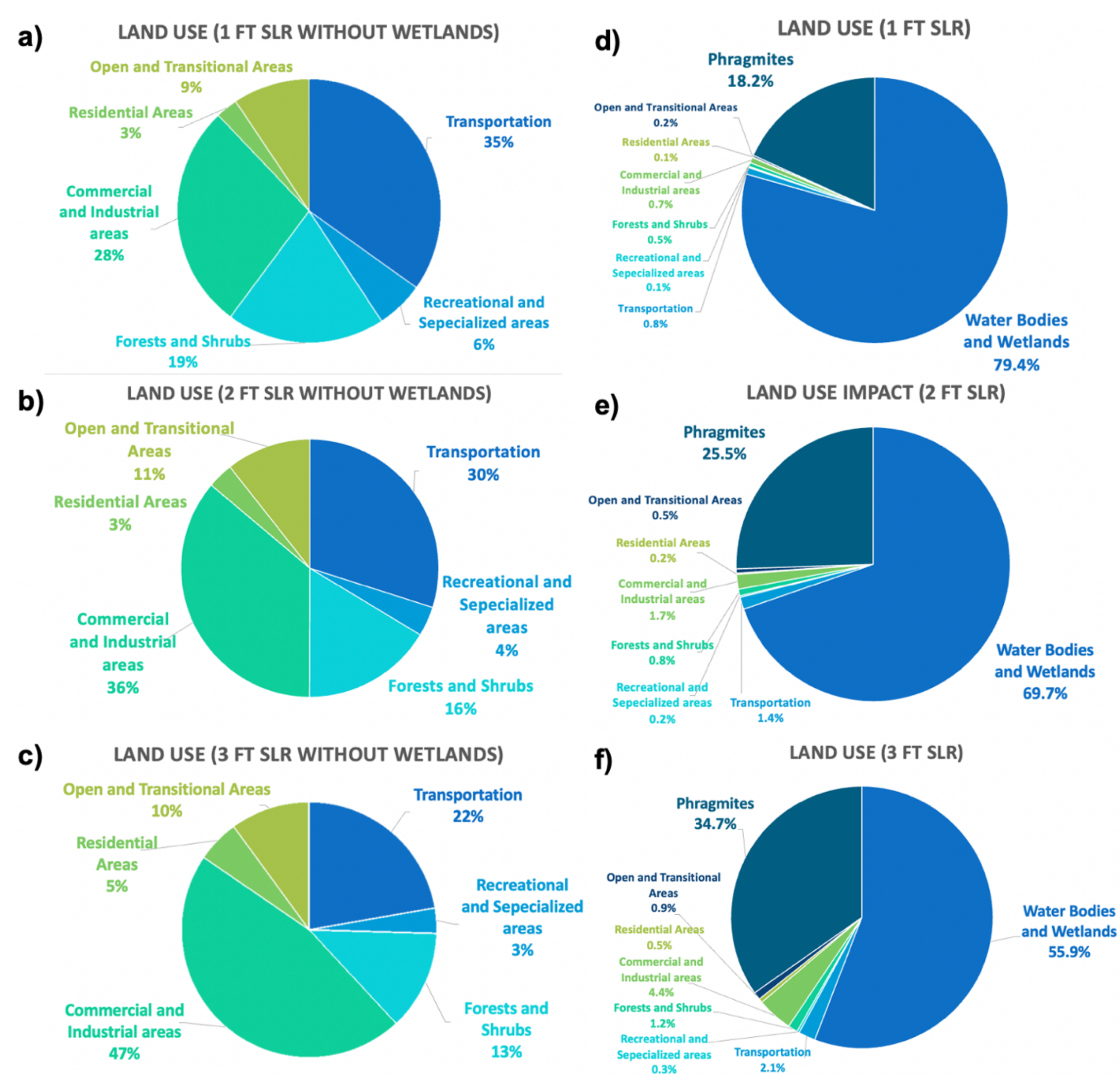
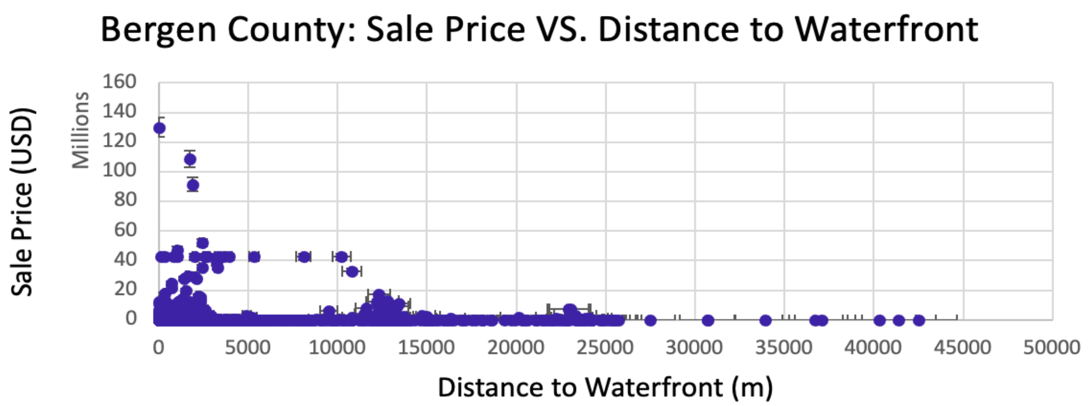


Figure 3: Based on 2020 Land Use data from the NJ Department of Environmental Protection: (a) percentage of each land use category except waterbodies, wetlands, and *Phragmites* affected at 1 ft of SLR (b) percentage of each land use category affected at 1 ft of SLR (c) percentage of each land use category except waterbodies, wetlands, and *Phragmites* affected at 2 ft of SLR (d) percentage of each land use category affected at 2 ft of SLR (e) percentage of each land use category except waterbodies, wetlands, and *Phragmites* affected at 3 ft of SLR (f) percentage of each land use category affected at 3 ft of SLR

There was an apparent negative correlation between property distance to waterfronts and sale prices in both counties (Figure 4). If a property is devalued due to flood risk, its neighbors experience a devaluation of property and increased insurance rates. This correlation suggests that those houses near wetlands may be prone to flooding, but the benefits of the scenic views, privacy, recreational opportunities, etc. may have outweighed the flooding risks. This trend, however, may reverse in the future when sea levels increase and flood boundaries are pushed back.



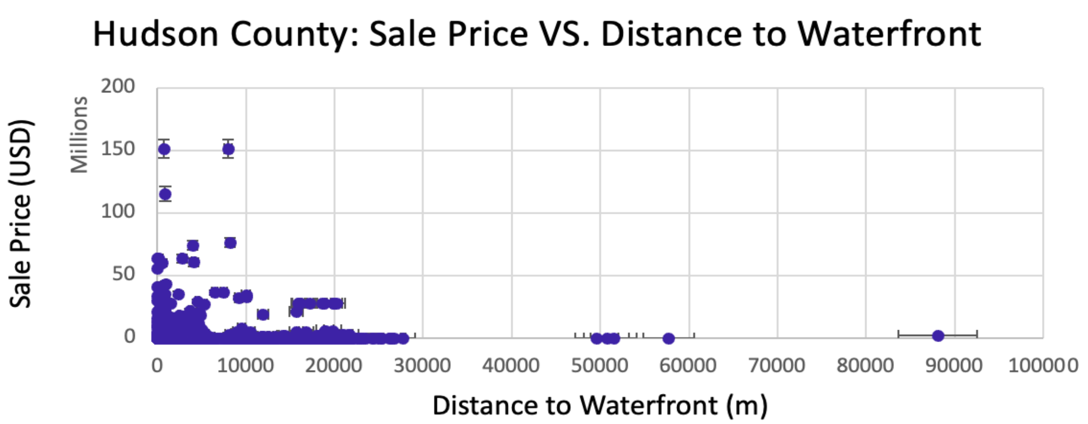


Figure 4: Dot plot showing the correlation between sale price and distance of properties to waterfront in the two counties that constitute the Meadowlands.

CONCLUSION

Climate change is one of the greatest threats to society, and the rise in global sea level is undoubtedly one of climate change's worst impacts. SLR threatens the livelihoods, economies, and ecosystems of coastal communities. This paper sought to quantify the socioeconomic impact of SLR in the New Jersey Meadowlands community by utilizing a DEM combined with a hedonic pricing model on QGIS. Our results suggest that there are significant economic impacts specifically related to commercial and industrial real estate. The results of the study are summarized below:

1) Without discounting, the real estate value impacted in the Meadowlands area ranges from $1.71 billion (1 feet of SLR projected in 2050) to $4.32 billion (3 feet of SLR projected in 2130).
    a) Bergen County losses ranges from $1.26 billion (1.02 percent of the total assessed value) to $2.33 billion (1.88 percent of the total assessed value), while for Hudson county, it ranges from $454 million (0.5 percent of the total assessed

value) to $1.99 billion (2.21 percent of the total assessed value).

2) As sea level increases, the percent increase of commercial, industrial, and residential areas affected surpasses that of ecological areas across all inundation scenarios (1, 2, 3 ft) (Table 2).
3) Wetlands, waterbodies, and *Phragmites* regions remain over 90% of all inundated regions under all three SLR scenarios mainly because they usually occupy areas with low elevation relative to sea level (Figure 3b, 3d, 3f)
4) Over 60,000 m^2 of transportation infrastructure could be inundated by 1 foot of SLR, showing how SLR could add to existing problems with commuting (Table 2).
5) There is a negative correlation between property distance to waterfronts and sale prices in the Meadowlands, indicating a real estate premium for waterfront properties (Figure 4). This premium may reverse in the future due to increasing sea levels and flood risks, despite the current benefits.

These results quantify the economic damages SLR could inflict on communities and would be valuable for urban planning in Meadowlands and other regions affected by SLR. Site-specific research on the impacts of SLR is essential for officials to plan accordingly. This work has several important limitations. Year and SLR predictions may not be representative depending on the trajectory of global emission cuts and other factors. In addition, the subsidence rates will likely not stay constant until 2130. There may have been changes to infrastructure since the 2014 collection of LiDAR elevation data used in this study. Real estate selling prices may not be up to date. Population shifts across space may shift real estate prices as well. Land use changes could occur before inundation affects the region. Future work can explore, in further detail, the specific sector-by-sector impacts of SLR.

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