Storm on the Horizon: Climate Change, Hurricanes, and the Future of the Eastern Caribbean

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Abstract

Hurricanes are a fact of life in the Caribbean. This meteorological reality has shaped the islands’ development throughout its history. However, in recent years, the Atlantic’s most fearsome storms have been unprecedented, both in strength and number. This paper explores the relationship between climate change and hurricanes and the effect this relationship has on the Eastern Caribbean. Chapter 1 uses quantitative data from a variety of sources, including the Intergovernmental Panel on Climate Change and the Millennium Ecosystem Assessment of the United Nations, as well as the National Oceanic and Atmospheric Association and the National Climate Assessment of the United States. This data establishes the particularly destructive nature of recent hurricanes, the effect this destruction has had on the people and ecosystems of the Eastern Caribbean, and the potential for future hurricanes to be more powerful and wreak more destruction because of climate change. Chapter 2 explores the impact of hurricanes, European imperialism, and American influence on the historical development of the Caribbean. Chapter 3 examines the current political and economic situation to evaluate the region’s vulnerability to hurricanes and the destruction they cause. Chapter 4 considers the ethical dimensions of the region’s exposure to consequences of climate change and its ability to adapt, given its historical political and economic history and small contribution to greenhouse gas emissions. Finally, drawing on the scientific, historical, political, economic, and ethical considerations of the issue, Chapter 5 presents policy solutions for adaptation to the new environmental realities of extreme tropical weather based on a global effort toward development in the region.

Keywords: climate change, climate change adaptation, Eastern Caribbean, environmental justice, hurricanes, Caribbean history, Caribbean economics
Acknowledgements

I would like to thank everyone who supported me throughout the writing process and who helped to make this paper possible. I am deeply grateful to the following people:

My family and friends for their unfailing support, especially throughout my college career and in all of my academic endeavors.

My many wonderful professors who have guided me as an Environmental Studies and liberal arts student and inspired me to meet the challenges of environmental crisis.

Dr. Rachel Annunziato for her support and the Fordham Undergraduate Research Program for allowing me to more deeply examine the problems presented in this paper.

Dr. John van Buren for his guidance and support throughout the course of my research, thesis, and undergraduate career.
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Introduction. Hanging on for Dear Life: Juan’s Story of Survival

On September 20, 2017, Hurricane Maria made landfall in Puerto Rico. Slightly weakened from the previous day, Maria battered the island as a Category 4 storm. Juan Gonzalez, an 87-year-old disabled veteran watched as the storm surge approached his home. To avoid the incoming deluge, Gonzalez hoisted himself from his powered wheelchair onto a table and clung to the iron bars of his windows for an hour as two feet of water inundated his home, and wind gusts of over 100 mph howled around him. His home was badly damaged, and the medical equipment for his spinal disability ruined. Gonzalez was left without electricity for twenty days, and over two months later still lacked potable water.¹

Juan Gonzalez’s story is not unique. Hurricane Maria ravaged Puerto Rico and the surrounding islands of the Eastern Caribbean. While able-bodied victims of the storm did not face the same struggles as Gonzalez, they also did not receive immediate aid. The organization Paralyzed Veterans of America provided help to Gonzalez in replacing medical equipment and repairing his home.² This aid is certainly warranted given his disability. However, many other victims languished during the painfully slow recovery. Puerto Rico has the support (at least in theory) of the United States government. As a large island with many inhabitants, Puerto Rico also receives global attention. However, the smaller islands of the Lesser Antilles are not afforded the same concern. The suffering and devastation left in the wake of hurricanes in this region is often ignored and forgotten by the global community.

The developed world has failed to accept its responsibility to assist the people of the Eastern Caribbean. Climate change is making hurricanes more destructive, and possibly more

² Ibid.
powerful. The region emits negligible levels of greenhouse gases but is forced to bear the brunt of some of climate change’s impacts. Developed countries that contribute the most to climate change have a duty to assist the victims of their actions. Moreover, the islands’ ability to cope with hurricane damage is shaped by their painful histories of colonialism. European and American domination of the region and modern globalization has hindered economic development, leaving the islands ill-equipped to deal with extreme weather. Climate change itself is tied up in this colonial history, as former colonizers pollute the Earth’s atmosphere. It is clear that the region’s wellbeing is primarily the responsibility of the developed world.

The complex causes and solutions of climate change driving this issue are many. While I hope this paper demonstrates the necessity of immediate and widespread action to address the threat, climate change mitigation is beyond the scope of my inquiry. Instead, I focus on methods of adaptation the Eastern Caribbean can implement to deal with extreme weather. Regardless of what action is taken to mitigate greenhouse gas emissions, hurricanes will continue to batter the region with worsening consequences. Therefore, it must adapt to this new reality, with the help of the developed countries that have contributed to it.

This paper is not meant to be a comprehensive study of each individual island. The research required for such an in-depth analysis is lacking. Instead, I provide an overview of the region and the challenges it faces. Chapter 1 provides quantitative data to show the relationship between climate change and hurricanes and the devastation this relationship causes in the Eastern Caribbean. Chapters 2-4 explore the historical, political, economic, and ethical dimensions of the problem. Finally, Chapter 5 offers policy recommendations to adapt the region, with the help of developed nations, to the new reality of hurricanes in the time of climate change.
Chapter 1. Climate Change Heating Up the Atlantic

Hurricanes are powerful forces of nature that leave death and destruction in their wake. The islands of the Eastern Caribbean are particularly vulnerable to these storm systems. When hurricanes strike, inhabitants must cope with the life-threatening consequences for long periods of time. While much can be done to limit damage and loss of life, hurricanes are natural disasters. Atmospheric conditions and weather patterns well outside the direct control of humans cause hurricanes to form and determine their strength and path. Therefore, the actions of humanity cannot prevent these unpredictable and formidable storms. However, humans are indirectly impacting hurricanes through climate change, making them more destructive and potentially stronger. This concerning trend is significantly harming the peoples of the Eastern Caribbean in devastating and often ignored ways.

*The Eastern Caribbean.* There is no set definition of which lands make up the insular Eastern Caribbean. The islands I include are by no means an exhaustive list. Rather, I have chosen a sample that represents the diverse geographic, political, and economic realities of the region. They include the United States territory of Puerto Rico, an island of the Greater Antilles; and the northern Lesser Antilles, specifically the Leeward Islands and most of the Windward Islands. These include the U.S. Virgin Islands; the United Kingdom territories of the British Virgin Islands, Anguilla, and Montserrat; the French territories of Saint Martin (the northern half of the island), Guadeloupe, and Martinique; the Dutch territories of Saba, Sint Eustatius, and Sint Maarten (the southern half of the island); and the independent nations of Antigua-Barbuda, St. Kitts-Nevis, Dominica, St. Lucia, and Barbados.\(^3\) With the exception of the French territories, all of these islands are recognized by the United Nations as small island developing states (SIDS),

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which experience unique economic and environmental challenges due to their small size and insular geography. In particular, their geographic isolation, lack of natural resources, economic reliance on foreign markets, and vulnerability to natural disasters threaten their development. Chapter 3 covers these factors in greater detail.\(^4\) I refer to these insular territories and nations as the Eastern Caribbean.

*Figure 1. The Greater Caribbean\(^5\)*

The island chain of the Eastern Caribbean extends beyond my definition of the region to the South American coast. As I explain later, the islands south of Saint Lucia are at a lower risk of hurricanes due to their latitude, so I am not including them in my analysis. Although Barbados

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is included here, it is arguably the most economically stable country in the Eastern Caribbean, as I discuss in Chapter 3. Therefore, it provides an excellent economic example for other island nations. It is important to note that the small islands of the Lesser Antilles are actually at a lower risk for hurricanes than their larger neighbors to the west, including the Dominican Republic, Haiti, Jamaica, and Cuba. However, these islands receive much more global attention and are better studied than those of the Eastern Caribbean, which are often forgotten. For these reasons, I have chosen to focus on the islands mentioned above, the “Eastern Caribbean.”

Figure 2. The Eastern Caribbean.

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The islands of the region are geologically related, although Puerto Rico shares more characteristics with Jamaica and Hispaniola, islands of the Greater Antilles. The region is geologically young, having formed within the last 200 million years. The north and south coasts of Puerto Rico are coastal plains that flank its “central mountainous spine.” The rest of the islands are part of the Lesser Antilles, which contain western and eastern arcs that reach south to Venezuela. The eastern island arc formed first. It stretches north from Barbados to the Bahamas. Volcanic activity created this island chain, but it is now low-lying and “consists of volcanic bases capped by thick limestone.”

The western arc also formed from volcanic activity on the boundary of the North and South American plates. These islands stretch north from Grenada and are home to active volcanoes. The most extreme example of volcanic risk is Montserrat. The 1995 eruption of the Soufrière Hills Volcano destroyed two-thirds of the island and buried its capital city of Plymouth in debris. In contrast to the other islands in the arc, Saint Lucia is home to the dormant Twin Pitons volcanic plugs, which do not pose a risk of eruption. Due to the movement of the Caribbean and American tectonic plates, earthquakes are a risk to all islands, raising the rare threat of tsunamis.

Despite their geological similarities, the islands of the Eastern Caribbean differ in their geography and political and economic systems. Moreover, there is a dearth of scholarly research and scientific data about the Lesser Antilles, especially because of their small size. However, as I show in Chapter 2, the islands share a history of slavery and colonial domination that links their political, economic, and cultural development. These similarities allow for analysis of the region.

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9 Ibid.
as a whole, as the realities of one island often parallel those of another. For these reasons, I use two locations as case studies that are emblematic of the region’s diversity and are better studied than their neighboring islands: Dominica and Puerto Rico.

Dominica is an independent nation that experiences some of the most severe problems in the region. It has the lowest ranking on the United Nations Human Development Index of any country in the Eastern Caribbean (103) and is second in the insular Caribbean only to Haiti (168).\footnote{United Nations Development Programme, \textit{Human Development Indices and Indicators: 2018 Statistical Update} (New York: 2018), accessed November 5, 2019, http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf, 22-24.} As I discuss later in the chapter, Dominica was also hit hardest by Hurricane Maria. Despite these challenges, Dominica’s Prime Minister Roosevelt Skerrit declared that the country will be the first “climate resilient” nation in the world in the wake of Maria. Dominica has released a comprehensive plan to achieve this goal,\footnote{Dominica, \textit{National Resilience Development Strategy: Dominica 2030}, 2018, accessed November 5, 2019, http://www.dominica.gov.dm/images/documents/national_resilience_development_strategy_2030.pdf.} making it an ideal candidate for analysis of vulnerability in the Eastern Caribbean.

Puerto Rico is a U.S. territory and was also devastated by Maria. The U.S. includes Puerto Rico in many of its disaster and climate change risk analyses, such as the National Climate Assessment, that provide helpful data to assess the island’s vulnerability. Moreover, analysis of Puerto Rico sheds light on the United States’ treatment of climate change risks in its territory, a particularly interesting area to explore given the country’s exorbitant greenhouse gas emissions noted below.

My focus on these two islands does not replace an analysis of the entire Eastern Caribbean. However, this approach allows for greater depth into the climatological, geographic, political, economic, and cultural realities of the region. Dominica and Puerto Rico do not
encompass the full diversity of the surrounding islands but provide concrete examples of the general overview of the Eastern Caribbean and enhance understanding of hurricane risk, factors contributing to the region’s vulnerability, and potential solutions to build resiliency.

_Hurricanes_. Having defined the Eastern Caribbean and the challenges associated with its study, we can now turn to the meteorological phenomena that affect the region. Hurricanes are tropical cyclones that occur in the North Atlantic, including the Caribbean. The term comes from Huracán, the “evil god of winds and destruction” in the Indigenous cultures of the region. A tropical cyclone is a “low-pressure system originating over tropical or subtropical waters with organized convection (i.e., rain shower or thunderstorm activity) and definite cyclonic surface wind circulation.” They are categorized by “maximum sustained surface winds,” which the World Meteorological Organization defines as a “ten-minute average wind at an elevation of ten meters.” However, the United States defines them using a one-minute average. Tropical depressions have winds of less than 39 mph, tropical storms winds of 39 mph and less than 74 mph, and hurricanes winds of 74 mph or more.13

Hurricanes are further classified using the Saffir-Simpson Scale, a measure of five categories based on maximum sustained surface wind speed. Categories are determined with the following wind speeds: Category 1, 74-95 mph; Category 2, 96-110 mph; Category 3, 111-130 mph; Category 4, 131-155 mph; and Category 5, 155+ mph. Category 1 and 2 storms generally cause minimal to moderate damage and flooding.14 Category 3, 4, and 5 hurricanes are classified

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as “major.” Hurricane development requires very specific environmental conditions that generally occur in the North Atlantic during summer and fall. Surface sea temperatures must be at least 27° C. Sea temperature determines evaporation, which allows storms to grow and develop through the accumulation of water vapor. Cyclonic vorticity, “a pre-existent degree of ‘spin’ in the air,” is also crucial to development, given hurricanes’ characteristic cyclonic motion. For this reason, latitude is also important. The Earth’s spin prevents cyclonic vorticity near the equator because of the Coriolis effect, relegateing hurricanes to latitudes of 5° N and S or greater. While all of the islands of the Caribbean are technically within this hurricane zone, they are less common south of Saint Lucia due to this lessened cyclonic vorticity. The formation of cumulus clouds is another critical ingredient in the growth of hurricanes that requires a steep temperature gradient and humid air in the troposphere. Finally, wind shear, differential wind speeds in the upper and lower troposphere, is detrimental to hurricanes, so minimal shear is required for development.

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17 Ibid., 22-23.
Although tropical cyclones are relatively rare weather phenomena, the North Atlantic provides the conditions necessary to produce an average of eight hurricanes annually.21 Between 1900 and 2010, a hurricane or lesser tropical cyclone entered the Caribbean in all but six years.22 African easterly waves, meteorological disturbances produced by the temperature difference between the scorching Sahara and the cooler Gulf of Guinea, can often develop into tropical cyclones.

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storms and hurricanes. The easterly trade winds, produced by the Hadley cells of the tropics, carry the storms west across the Atlantic, where they can impact the Eastern Caribbean.²³

_Hurricane Impacts._ Hurricanes generally affect people and development in three ways—wind, rain, and storm surge. Wind can deal significant damage and is a strong indicator of intensity, hence its use for categorization. Strong winds can damage homes and other buildings, destroy critical infrastructure like power lines, and down trees.²⁴ Rain can also have devastating consequences, regardless of wind speed. In 1998, Hurricane Mitch, Category 5 at peak intensity, dropped over six feet of rain in Central America, killing more than 11,000 people.²⁵ At the other end of the wind-speed spectrum, tropical storms can deal extensive damage because of rainfall. A recent example is Hurricane Harvey, which weakened to a tropical storm shortly after landfall in 2017. The storm dropped over sixty inches of rain on Texas, causing widespread flooding and devastating damage.²⁶

Wind and rain have considerable potential for damage, but storm surge is the most dangerous and lethal threat. The low pressure of hurricanes draws seawater upwards, ranging from a few inches to as much as three feet, depending on the intensity of the storm. However, wind is the more significant cause of storm surge and can raise water levels more than forty feet. Wind exerts force on seawater that causes it to rise in the direction of the wind. As hurricanes approach shore, the ocean becomes shallower with the rise of the continental shelf, contributing

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²³ Emmanuel, _Divine Wind_, 43-45, 98.
²⁵ Emmanuel, _Divine Wind_, 182.
to greater surge. At landfall, the hurricane’s winds produce massive waves on top of the storm surge, inflicting severe damage to shorelines.27

*Hurricanes, Climate Change, and Ecosystem Services.* Climate change is affecting hurricanes and the damage they cause. However, before discussing this relationship, it is important to understand this problem in the context of ecosystem services. Climate change’s effects on hurricanes are examples of the degradation of natural capital—“the natural resources and natural services that keep [humans] and other forms of life alive.”28 Humanity is utterly dependent on natural resources and services. These ecosystem services can be grouped into four categories: provisioning, regulating, cultural, and supporting. Provisioning services supply natural resources, such as food, water, and timber. Regulating services provide the proper conditions to sustain life, such as climate, flood, and disease control and water purification. Cultural services are the “recreational, aesthetic, and spiritual benefits” humans enjoy from ecosystems. Finally, supporting services are the processes that other ecosystem services hinge upon, “such as soil formation, photosynthesis, and nutrient cycling.”29 The degradation of these essential ecosystem services brings the world closer to irreversible ecological tipping points, in which natural systems permanently shift in behavior.30 This disturbing trend poses a great threat to human survival and wellbeing.

Humanity is not degrading ecosystem services uniformly or without purpose. Rather, this degradation has served to promote human wellbeing, comprised of the “basic material for a good life, …health, …good social relations, … security, … and freedom of choice and action,” at least

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27 Emmanuel, *Divine Wind*, 147-151.
in the short term. For example, the global effort to enhance provisioning services, such as food, has degraded other types of ecosystem services.\textsuperscript{31} Impacts on human wellbeing involve indirect drivers of environmental change, namely “population size, economic activity, lifestyle, [and] technology.”\textsuperscript{32} These lead to changes in direct drivers, most notably for this discussion, natural events like hurricanes and climate change. Climate change helps to explain why 70% of regulating services are currently being degraded.\textsuperscript{33} In expanding economic activity and furthering affluent, wasteful, and highly consumptive lifestyles, humanity has caused climate change, a significant degradation of regulating services.

\textit{Climate (De)Regulation.} Climate change is the breakdown of climate regulation. It is a complex, global phenomenon that has a significant impact on the Eastern Caribbean’s vulnerability. It is caused by the greenhouse effect. When the Earth absorbs solar radiation, it reradiates it as infrared radiation, also known as heat. Water, methane, carbon dioxide, and other greenhouse gases in the atmosphere trap infrared radiation, preventing it from escaping to space. The process warms the planet, allowing livable temperatures.\textsuperscript{34} However, the addition of greenhouse gases to the atmosphere, especially carbon dioxide through the burning of fossil fuels, has amplified the greenhouse effect, causing average temperatures to rise. Since the mid-1700s, atmospheric carbon dioxide levels have risen 40% from 280 ppm to over 400 ppm.\textsuperscript{35}

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\textsuperscript{31} Millennium Ecosystem Assessment, \textit{Ecosystems and Human Well-Being}, v, 1.
\textsuperscript{33} Millennium Ecosystem Assessment, \textit{Ecosystems and Human Well-Being}, vii, 6.
\textsuperscript{35} Ibid., 9-12.
\end{flushleft}
Figure 4. The Greenhouse Effect\textsuperscript{16}

Nearly half of greenhouse gas emissions are the result of electricity and heat production, agriculture, forestry, and other land uses. Industry makes up approximately 21% of emissions, followed by transportation (14%), other energy uses (10%), and buildings (6%). In 2014, China was the worst emitter, responsible for 30% of greenhouse gas emissions. The United States came second with 15%, followed by the European Union at 9%.\textsuperscript{37} The Eastern Caribbean’s greenhouse gas emissions are negligible compared to the rest of the world.\textsuperscript{38}


\textsuperscript{38} United Nations Intergovernmental Panel on Climate Change, “Part B: Regional Aspects,” in Climate Change 2014: Impacts, Adaptation, and Vulnerability, Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, ed. Vicente R. Barros et al. (New York: Cambridge University Press,
The visible signs of climate change are many. According to the United Nations Intergovernmental Panel on Climate Change, or the IPCC, the period 1880 to 2012 saw an increase in global average land and ocean surface temperature of 0.85° C. The upper 75 meters of the ocean increased in temperature by 0.11° C each decade between 1870 and 1971. Moreover, the 1980s, 1990s, and 2000s each successively became the hottest decades on record, while 1998, 2005, 2010, and 2014 were successively the hottest years on record. The IPCC predicts that average global temperature will rise from 0.3° to 0.7° C between 2016 and 2035.

This warming is causing sea level rise. Between 1901 and 2010, the global average sea level rose by 0.19 meters. Since the early 1990s, the rate of sea level rise has been almost 0.3 cm per year, double the average rate of the rest of the twentieth century.

The Eastern Caribbean is experiencing these climate change impacts. The IPCC reports that the average rate of sea level rise between the mid-twentieth century and 2012 in the entire Caribbean was 1.88 mm/year, close to the global average. It also predicts an increase in average surface temperature of 1.8° C to 2.3° C. The United States National Climate Assessment reports an increase in average surface temperatures in Puerto Rico of 1.5° F since 1950 and predicts an additional 1.5° F to 4° F increase in the area of Puerto Rico and the U.S. Virgin Islands by 2050. It predicts an increase of as much as 9° F by 2100. The NCA also reports an increase in water temperature in the Northeastern Caribbean of 0.23°F per decade between 1955 and 2016. When focusing on the last two decades, this rate increases to 0.43° F per decade.

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40 Romm, *Climate Change*, 3.
43 United Nations Intergovernmental Panel on Climate Change, “Part B: Regional Aspects,” 1619, 1627.
levels near Puerto Rico and the Virgin Islands have risen approximately 0.08 inches since 1950, although this rate has increased since 2000. Depending on the future rate of emissions, the NCA projects sea levels to rise from 0.8 to 2.8 feet by 2050 and 1.6 to 10.2 feet by 2100.\textsuperscript{44} Even without the threat of hurricanes, sea level rise is becoming a dire problem for the region.

\textit{Climate Change and Hurricanes.} Although the effects of climate change on hurricanes are not entirely clear, it appears that it has made them more powerful and destructive. Hurricanes’ maximum potential intensity can be measured by the temperature difference between the ocean and the lower stratosphere, the upper limit of hurricanes. Climate change is causing the temperature of the ocean and the troposphere to rise, but not that of the stratosphere. The result is a greater temperature difference, and therefore a greater potential intensity. The increase in potential intensity does not guarantee that hurricanes will be more intense.\textsuperscript{45} The IPCC predicts that the wind speed and precipitation of hurricanes are likely to increase, but this projection is low confidence.\textsuperscript{46} However, the forces that act against hurricanes, like wind shear and dry air, are generally random, so future hurricanes are likely to approach their maximum potential intensities at the same rate current ones do. Therefore, it seems likely that climate change will intensify hurricanes. What is unknown, however, is how climate change will affect the frequency of storms, as meteorological science cannot explain current frequency.\textsuperscript{47}

If warmer seas do strengthen hurricanes, the Eastern Caribbean is at a greater risk. As shown above, the average surface temperature of the ocean has risen consistently since the 1870s, raising the maximum potential intensity of storms. There is also evidence to support the

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\textsuperscript{46} United Nations Intergovernmental Panel on Climate Change, “Part B: Regional Aspects,” 1163.
\textsuperscript{47} Sobel, \textit{Storm Surge}, 207, 210-213.
\end{flushright}
increasing intensity of hurricanes. The proportion of Category 4 and 5 hurricanes has increased since 1975 by 25-30% for every degree Celsius of warming.\textsuperscript{48} This increase is evident in the extraordinary 2017 hurricane season. Ten successive hurricanes, six of which were major (Category 3, 4, or 5) formed in the Atlantic Basin.\textsuperscript{49} Of these storms, Maria and Irma, the third and fifth costliest hurricanes in U.S. history, inflicted the most damage in the Eastern Caribbean.\textsuperscript{50} It is important to note that this season could have been a random anomaly. Moreover, data inconsistencies resulting from older, less accurate meteorological equipment means that the higher proportion of Category 4 and 5 hurricanes may reflect improved measurements rather than stronger storms.\textsuperscript{51} However, given the stakes involved, the theoretical and actual evidence is sufficient to raise alarm about future hurricane impacts in the Eastern Caribbean and take action to address them.

In contrast to the above uncertainty, it is clear that climate change will worsen hurricane impacts. As noted above, sea levels are expected to rise substantially in the Caribbean. This trend will exacerbate storm surges, which cause catastrophic flooding and damage. In addition, the increase in water vapor in storm systems increases rainfall and flooding. Because climate change is warming up the surface of the ocean, more water vapor is entering hurricanes, resulting in torrential rain and greater freshwater flooding.\textsuperscript{52} Therefore, sea level rise and warmer oceans contribute to hurricane-induced flooding, even if the hurricane itself is not particularly powerful.

\textsuperscript{48} Romm, \textit{Climate Change}, 59.
\textsuperscript{52} Romm, \textit{Climate Change}, 39, 55-56.
Regardless of the impact climate change has on the formation and strength of hurricanes, it will worsen their consequences.

_Hurricanes, Provisioning and Cultural Services, and Human Wellbeing._ Hurricanes are natural drivers of environmental change and often negatively impact provisioning and cultural services. When a hurricane makes landfall, the ensuing wind, rain, and storm surge usually cause immediate death and destruction. These are the direct harms to human wellbeing. However, the aftermath of the storms is often far worse and leads to many indirect deaths. Indirect forces, such as the destruction of infrastructure, can cut off access to food, freshwater, and medical care, adding to the death toll. Hurricanes also leave stagnant pools of water where mosquitoes can breed, contributing to the spread of infectious diseases.\(^53\) The loss of provisioning services like food, clean water, and healthcare significantly harm human wellbeing.\(^54\)

In addition to physical impacts, hurricanes can deal psychological trauma. Depending on the extent of the damage, this can be the result of a loss in cultural services. The loss of a stable environment is akin to the loss of a cultural ecosystem service. The most extreme example of this loss is evacuation. Moreover, relocation and the failure of relief agencies and organizations to assist victims in the aftermath of a hurricane inflicts further trauma to the experience of the storm’s devastation.\(^55\)

Some of the most extreme harms to human wellbeing because of hurricanes were visible in the 2017 season. Hurricane Maria is an example. Dominica was proportionately hit hardest by Maria, then a Category 5 hurricane with sustained winds of over 166 mph. Maria is the strongest

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\(^{54}\) Lopez-Marrero and Wisner, “Not in the Same Boat,” 138-139, 144.

\(^{55}\) Appendix.
hurricane to hit Dominica on record. The island received about 22 inches of rain. There were 31
direct deaths with 34 reported missing. The storm caused $1.31 billion in damage,\textsuperscript{56} catastrophic
for a country whose GDP in 2016 was approximately $581 million.\textsuperscript{57} The National Hurricane
Center reported that the “once-lush tropical island was effectively reduced to an immense field of
debris.” Maria reduced the island to rubble, damaged the majority of its trees, vegetation, and
buildings, and destroyed the entire agricultural sector.\textsuperscript{58}

Puerto Rico also experienced catastrophic damage from Maria. Combined with the U.S.
Virgin Islands, Puerto Rico sustained $90 billion in damage in the most destructive hurricane the
islands have experienced in modern times. Storm surge and river flooding inundated Puerto
Rico. The island received almost 38 inches of rain. The storm downed 80\% of the island’s utility
poles, leaving virtually all 3.4 million residents without power. By the end of 2017, half of the
population still lacked electricity. Power was restored to only 65\% of residents by the end of
January 2018. Shortly after the storm, the official death toll was reported as 65.\textsuperscript{59} However, in
August of 2018, the government of Puerto Rico accepted the results of a study led by researchers
at George Washington University that put the death toll at 2,975.\textsuperscript{60} The destruction caused a
mass exodus from the island. Over 40,000 Puerto Ricans emigrated to the mainland U.S.,
although this number only reflects those who registered with the Federal Emergency

\textsuperscript{58} National Oceanic and Atmospheric Administration, National Hurricane Center, \textit{National Hurricane Center Tropical Cyclone Report: Hurricane Maria}, 7.
\textsuperscript{59} Ibid., 6-7.
\textsuperscript{60} Sheri Fink, “Nearly a Year After Hurricane Maria, Puerto Rico Revises Death Toll to 2,975,” \textit{New York Times},
Management Agency. The real number could be as high as 160,000. This migration and the lack of relief services deals significant psychological trauma to victims. Thus, Hurricane Maria devastated Puerto Rico, severely damaged provisioning services, such as food production and access to electricity and clean water, led to severe psychological injury, harmed human wellbeing, and caused great loss of life.

Figure 5. Puerto Rico After Maria

63 Appendix.
Climate Change and Hurricane Defense. In light of the serious dangers hurricanes pose to the Eastern Caribbean, there are a number of adaptative strategies that the islands can implement to address the rising risks. These measures can be classified into four categories: hard-protect, soft-protect, store, and retreat. Protect strategies are designed to prevent water from coming ashore and causing flooding. Hard-protect refers to “engineered, gray solutions” that dominate coastal protection. They include seawalls, revetments, breakwaters, floodwalls, dikes, and surge barriers. These defenses are often effective, long-lasting, and take up minimal amounts of space. They can be integrated into urban landscapes or have multiple uses. However, they are generally very expensive and require a considerable amount of maintenance.\(^\text{65}\)

In contrast to hard-protect, soft-protect or “green” strategies use natural systems to defend coastlines. Examples include living shorelines, dunes, and beach nourishment. Living shorelines are “gently sloping natural banks that reduce shoreline erosion, protect coastal ecosystems, and help reduce storm surge strength.” They function as buffers while providing habitat for plants and animals and promoting biodiversity. Dunes serve as natural barriers that protect against flooding and provide habitat for coastal organisms. These strategies are generally cheaper than gray solutions and require less maintenance but are more vulnerable to human use and extreme weather, reducing their effectiveness. For example, dune grasses that stabilize sand cannot withstand trampling, while intense wave action can erode dunes and living shorelines.\(^\text{66}\)

The protection these natural strategies provide are an example of regulating ecosystem services.

Unlike protect strategies, store and retreat “accommodate” water, but aim to keep it from development. Store involves holding water inland until it can drain back to the sea or infiltrate the ground. These strategies include floodable plains, squares, and “green infrastructure” that


\(^{66}\) Ibid., 87-95.
promote infiltration. Low-lying parks along rivers and in urban areas can collect and hold excess water. Parks and drainage ways can be situated along coasts to protect against storm surge events. Retreat also involves providing more land for water to flood by raising development or relocating inland. While store strategies are generally inexpensive and low maintenance, retreat is costly and faces immense political and social challenges. Both strategies require considerable amounts of land, which may be less feasible in the smaller islands of the Lesser Antilles. However, a combination of hard-protect, soft-protect, store, and retreat strategies that are focused on integration with local communities, provide, multipurpose uses, and are tailored to the environmental and social conditions of each locality can mitigate flooding.

**Conclusion.** The Atlantic experiences dangerous hurricanes that threaten the inhabitants of the Eastern Caribbean. Climate change exacerbates this problem by potentially strengthening storm systems and contributing to flooding through sea level rise and increased water vapor. Thus, the degradation of climate regulation, a crucial ecosystem service, worsens hurricanes and their consequences. The loss of provisioning services ultimately harms human wellbeing in significant and devastating ways. The islands of the Eastern Caribbean lack the resources, land, and infrastructure to cope with this degradation of services, leaving them especially vulnerable to extreme weather. The strength of hurricanes enhanced by climate change and the damage they cause in this region require attention. To understand the ways in which hurricanes affect the islands, however, we must first examine their political, economic, and ecological realities. We turn now to the turbulent history of the region that created those realities.

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68 Ibid., 8-14.
Chapter 2. The Stormy History of Imperialism, Slavery, and American Hegemony

The Eastern Caribbean is a diverse and complex region, composed of multiple islands with different political, economic, and cultural realities. However, the islands share a natural and political, and economic history that has cultivated and continues to inform their various identities. The natural phenomena of the region, specifically its geography and meteorology, has shaped its development in the pre-Columbian, European, and postcolonial eras. This driving natural force has remained fairly consistent in modern history, though as mentioned in the previous chapter, the storms that have always battered the region may be worsening, and the seas rising. The same cannot be said of the influences of empire. European colonialism and its complement, African slavery, forced turbulent, extensive, and often violent change on the islands. After the decline of European influence, the United States took its place. Imperialism has defined the region for much of its modern history. As seen in the next chapter, this imperial legacy haunts the Eastern Caribbean and determines the islands’ ability to cope with hurricanes of increasing magnitude and destructive capacity.

Storms of the Past. Climate change may be exacerbating hurricanes, but it certainly did not invent them. Extreme tropical weather has been a constant in the Eastern Caribbean and has influenced its development. Perhaps most emblematic of the power of hurricanes to define history is their impact on which events, people, and texts of the past are remembered and which are forgotten. They can quite literally erase history by destroying archives in the region.69

In a much more concrete way, the ever-present threat of hurricanes exerted considerable influence on the lives and cultures of the region’s inhabitants. In Puerto Rico, the Indigenous Taíno people constructed huts that withstood the strength of the storms in settlements built back

from the coast to protect against flooding. They also planted hurricane-resistant root crops. Moreover, the storms featured prominently in their religious practices. Islanders deified them and used them to measure time. As noted in the previous chapter, the word “hurricane” comes from the Indigenous deity Huracán. In the Lesser Antilles, the Caribs similarly grew accustomed to the storms, gained the ability to recognize the conditions preceding their arrival, and established adaptive practices.\(^7\) Thus, hurricanes have always played a prominent role in the lives of Eastern Caribbean islanders, shaping their early epistemologies and culture.

Hurricanes also had a strong impact on the Europeans who colonized the region and the societies they established. The storms raised Christian theological concerns. Europeans demonized the Taíno and Caribs and justified their enslavement and subjugation based on their “satanic” abilities to predict storms.\(^7\) Hurricanes also impacted major historical events. The 1530 hurricane season devastated Puerto Rico. The Caribs living on Dominica, also affected by the storms, raided the Spanish settlement. The surviving colonists imported domestic dogs to assist them in protection against Carib raids, which caused a serious feral dog problem for two centuries. The storms even impacted military outcomes. In 1666, an English naval attack against the French island of Guadeloupe was foiled by a hurricane that sank a seventeen-ship fleet and killed 2,000 soldiers.\(^7\) As noted in the previous chapter, Guadeloupe is still a French territory. The influence of hurricanes can be seen throughout the history of the Eastern Caribbean in similar episodes.

*Europe, the Caribbean, and Empire.* In 1492, Christopher Columbus “discovered” the Americas after landing in San Salvador, an island of the Bahamas.\(^7\) The arrival of this European

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\(^7\) Schwartz, *Sea of Storms*, 5-9, 18.  
\(^7\) Ibid., 21-24.  
\(^7\) Ibid., 36-37.  
\(^7\) Gibson, *Empire’s Crossroads*, 17.
explorer proved to be one of the greatest turning points in the modern history of the Caribbean, if not the world. At first, Europeans struggled to cope with hurricanes and adapted poorly. The storms were completely new phenomena that had no precedent in the classical or theological scholarship of sixteenth-century Europe. Although the colonists regarded the native islanders as “savages” and viewed their culture with disdain, they eventually gained the ability to predict storms through Indigenous knowledge, often by reading the actions of animals. Although helpful, this skill certainly did not shield them from the devastating storms, which undermined colonial interests and human wellbeing for centuries. Indeed, the colonists regarded hurricanes “as one of the inescapable dangers of living or doing business in the [Caribbean].”

Despite the adaptative advantage the colonists gained from Indigenous peoples, their relationship was not friendly. The Spanish were the first to establish colonies in the region on the Greater Antilles islands of Hispaniola, Cuba, Jamaica, and Puerto Rico by 1550. They brutally massacred and subjugated Indigenous peoples in a system of slavery known as encomienda. The enslaved islanders were forced to work in fields and mines. As Spanish conquest shifted west to the American continent after 1520, their Caribbean holdings received less attention. However, the islands remained home to the ports that connected the New World to Spain and established agrarian economies built on slave labor. Diseases brought from Europe and Africa, such as smallpox, yellow fever, and malaria, decimated the Indigenous populations. Their vulnerability greatly facilitated European conquest. This “ecological imperialism,” as Alfred Crosby

74 Gibson, Empire’s Crossroads, 7.
75 Schwartz, Sea of Storms, 9-12, 24-25.
76 Ibid., 30.
77 Ibid., 33.
78 Gibson, Empire’s Crossroads, 38-45.
79 Schwartz, Sea of Storms, 35.
80 Gibson, Empire’s Crossroads, 831
describes the introduction and rapid spread of Afro-Eurasian biota in the Americas, had dire consequences for the Caribbean. By the end of the sixteenth century, the Taino of the Greater Antilles had been completely wiped out.\textsuperscript{82}

The English, French, and Dutch arrived in the region soon after the Spanish in the early sixteenth century. At first, they simply raided Spanish ships and settlements. The political divides between Catholic and Protestant nations caused by the Reformation contributed to the piracy.\textsuperscript{83} With the expansion of the global tobacco trade, the English, French, and Dutch established their own colonies in the Lesser Antilles.\textsuperscript{84}

England began to colonize the region in 1623 with its settlement on Saint Kitts. It quickly expanded to the nearby islands of Barbados, Nevis, Antigua, and Montserrat, and in 1655, conquered the Spanish island of Jamaica. French colonies were created around the same time. France shared Saint Kitts with England and colonized Martinique, Guadeloupe, Saint Martin, and Grenada.\textsuperscript{85} France also colonized Dominica, but lost the island to the British in 1761 during the Seven Years War.\textsuperscript{86} The French also settled western Hispaniola and later gained official control from the Spanish of the land that would become Haiti. The Dutch, motivated by their desire to free the Netherlands from Spanish control, established small colonies built on trade that were used by every European power on Saint Martin, Saba, and Eustatius. The last colonizers, the Danish, settled the modern U.S. Virgin Islands in the late seventeenth and early eighteenth centuries. The political demarcations of the region were fluid. Settlements were often home to colonists from several European nations, and control of the islands shifted throughout the

\textsuperscript{82} Schwartz, \textit{Sea of Storms}, 35.
\textsuperscript{83} Gibson, \textit{Empire’s Crossroads}, 46-50.
\textsuperscript{84} Ibid., 61-54.
\textsuperscript{85} Schwartz, \textit{Sea of Storms}, 43-46.
\textsuperscript{86} Gibson, \textit{Empire’s Crossroads}, 134.
colonial period.\textsuperscript{87} However, as we will see in the next chapter, the historical dominance of specific European nations continues to impact the modern Eastern Caribbean.

\textit{Figure 6. European Colonies}\textsuperscript{88}

As European colonization expanded in the seventeenth century, export agriculture became the main industry. As mentioned above, Indigenous peoples were enslaved and forced to grow tobacco. However, as the European presence in the region grew and developed, both the crop and the labor used to cultivate it changed. Sugar had been a rare and highly prized commodity in Europe since its introduction in the Middle Ages, but the continent lacks the wet, tropical climate needed to grow the crop. Many of the Caribbean islands provided the proper

\textsuperscript{87} Schwartz, \textit{Sea of Storms}, 43-46.
\textsuperscript{88} \textit{Figure 6. European Colonies}, University of Duisberg-Eisen, accessed November 22, 2019 https://www.uni-due.de/SVE/VARS_Caribbean.htm.
agricultural conditions and offered a very lucrative opportunity to raise sugar. The Spanish grew sugar in Puerto Rico, while the English, French, and Dutch established plantations in the Lesser Antilles. The colonists continued to grow tobacco, as well as coffee, indigo, and cacao. However, sugar is more hurricane resilient, a quality that cemented its supremacy in the region.

When the sugar empire was in its infancy, Indigenous slaves, European indentured servants, and some African slaves worked the plantations. However, Indigenous people fell prey to diseases brought from Europe. Likewise, Europeans often succumbed to malaria introduced by African slaves. Africans generally had immunity to these diseases and were therefore viewed as “better suited” to the region. This led to a massive increase in the importation of African slaves beginning in the mid-seventeenth century.

The rise of export agriculture made plantation slavery one of the most defining aspects of the Caribbean colonies. The eighteenth century witnessed the importation of a million enslaved Africans to the region. By the early nineteenth century, slaves made up 85% of the population of the British West Indies, vastly outnumbering the 7% who were Europeans. This social makeup coupled with high mortality and heavy reliance on European immigration and slave importation contributed to a general sense of fear and unease. Hurricanes exacerbated the lack of social cohesion in these societies and contributed to fears of slave revolts and anarchy. Unsurprisingly, slaves suffered the most serious hurricane impacts. In the immediate aftermath of a hurricane in 1723, about twenty slaves died each day from starvation. Even in calm weather, the Caribbean’s version of slavery was one of the most brutal practices of European colonialism. It involved rape,

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89 Gibson, Empire’s Crossroads, 83-88.
90 Schwartz, Sea of Storms, 46-47, 73.
91 Gibson, Empire’s Crossroads, 31, 83-91.
92 Schwartz, Sea of Storms, 47-49.
“floggings, beatings, and imposed humiliations.” Despite the horrors and flagrant cruelty of the practice, it was ardently defended for years.\textsuperscript{93}

\textit{Figure 7. Slaves Working a Sugar Plantation on Antigua, 1823}\textsuperscript{94}

The explosion of the sugar economy in the Caribbean, another example of ecological imperialism in the region, had detrimental effects to its inhabitants. The dependence on exports meant that the majority of the population lived in areas home to major ports along rivers and the coast that traditionally served as buffers between Indigenous peoples and the sea, eliminating natural coastal defense. This settlement pattern placed people directly in harm’s way, especially from storm surge. Moreover, plantation agriculture and a drive to conquer the “uncivilized” wilderness led to widespread deforestation in the region. Colonists virtually eliminated the forests of Barbados, St. Kitts, and Nevis. Deforestation increased rates of erosion and provided

\textsuperscript{93} Schwartz, \textit{Sea of Storms}, 79-80, 91.
open land where stagnant pools of water, ideal for mosquito breeding, could form.\textsuperscript{95} Thus, the sugar economy degraded regulating ecosystem services on many of the islands, amplified the impacts of hurricanes, and reduced human wellbeing.

Agriculture also harmed provisioning services in the region. The preference for sugar and other cash crops rendered subsistence food production a secondary concern, which led to shortages in this very important provisioning service, even in years without major disasters. In the wake of hurricanes, which often struck around the time of harvest, hunger was a major concern. The storms often destroyed crops and seeds that affected the next season. This lack of food was especially problematic for the smaller islands of the Lesser Antilles, which had to rely on imported supplies. Hurricanes also contaminated water supplies with salt, killed livestock, and provided stagnant water conducive to the reproduction of mosquitoes and other disease-carrying pests. These impacts coupled with the food shortages contributed to high incidences of disease among the populations that survived the initial hit of the storm, significantly harming human wellbeing. Although wealthy planters noticed that years after hurricanes often produced greater harvests, this silver lining did little to console most of the region’s inhabitants who suffered from the additional harms of extreme weather well into the nineteenth century.\textsuperscript{96}

The second half of the eighteenth century laid bare the region’s vulnerability. In 1766, fifteen hurricanes made landfall in the Caribbean, affecting islands in each European empire. 1772 was another active year that witnessed nine hurricanes. However, the 1780s was one of the worst decades for hurricanes in the region’s history. The “great hurricane” of October 1780 killed between 22,000 and 30,000 people. The storm decimated Barbados, St. Lucia, Martinique,

\textsuperscript{95} Schwartz, \textit{Sea of Storms}, 47, 72-73.
\textsuperscript{96} Ibid., 40-42.
Guadeloupe, and the western coast of Puerto Rico. Hurricanes inflicted further damage throughout the decade. The storm patterns exposed the social tensions in the region and the inhumane conditions and suffering of slaves. Although they did not cause any major slave revolts, the hurricanes did inspire debates on slavery and the abolition movement.

*The Decline of Slavery and European Influence.* By the late eighteenth century, African slavery was the foundation upon which life in the Caribbean rested. The domination of white planters over their slaves defined the political, economic, and cultural realities of the region. A European baron on a visit to the Caribbean remarked that the colonies could not exist without slavery. The ideas of the Enlightenment and the American and French Revolutions, prompted the chain of events that would test that theory. A successful slave revolt in the French colony of Saint-Domingue from 1791-1804 created the Republic of Haiti. The Haitian Revolution led to the outlaw of the Atlantic slave trade by Britain, the United States, Sweden, the Netherlands, and Denmark by 1814. This was the beginning of a long and violent process that finally ended with the complete abolition of slavery in the region in the late nineteenth century. The end of slavery brought with it the close to the European era of the Caribbean, as its sphere of influence turned to the United States. Nevertheless, the region’s European history molded it for nearly four hundred years, cementing a legacy it has yet to escape.

*The Rise of American Power.* The United States began to exert considerable influence over its southern neighbors at the turn of the twentieth century. It won the territory of Puerto Rico in the Spanish-American War and became heavily involved in the newly independent

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98 Ibid., 104-105.
99 Ibid., 126-151.
100 Ibid., 154-173.
101 Ibid., 220-224.
country of Cuba. It established a military base at Guantanamo Bay and revived sugar plantations in the island nation. Further to the West, the U.S. prompted a Colombian revolution to build the Panama Canal. President Theodore Roosevelt added the Roosevelt Corollary to the Monroe Doctrine in 1904, which asserted the country’s authority to intervene in the Caribbean. In 1917, Denmark sold St. Thomas, St. Croix, and St. John, known today as the U.S. Virgin Islands, to the United States. In the context of World War I, the U.S. sought the purchase to keep Germany out of the region. On other islands, American companies purchased large tracts of land for sugar plantations, effectively giving the U.S. complete economic control in the region.

Figure 8. Political Cartoon of American Hegemony in the Caribbean, 1904

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103 Gibson, Empire’s Crossroads, 223-234.
104 Blouet, The Contemporary Caribbean, 41.
105 Gibson, Empire’s Crossroads, 241-243.
106 Blouet, The Contemporary Caribbean, 42.
The extent of American influence in the Caribbean was made clear during the Great Depression. The stock market crash of 1929 tanked the global economy. Coupled with tariffs the U.S. enacted to protect American sugar, the slowdown plunged the entire Caribbean into an economic depression, revealing the dependence of the region on the U.S. The resulting poverty caused labor protests and the rise of communism throughout the region, setting the stage for independence movements and military intervention during the Cold War.\textsuperscript{108}

\textit{War, Independence, and Modern Life.} The labor protests caused by the Great Depression and the strain of World War II on Europe and the Caribbean planted the seeds of independence. World War II did not spare the region. The European colonies provided their Allied motherlands with raw materials, such as oil, to fuel the war machines.\textsuperscript{109} The mobilization for war helped bring the region out of its economic slump.\textsuperscript{110} However, its involvement in the Allied war effort made it a target of German submarines.\textsuperscript{111} The collapse of France made the situation worse. Vichy France, the puppet government allied with Germany, exerted its control over the French islands, causing a mass exodus of refugees and severe supply shortages. These developments caused living conditions and human wellbeing to decline on all islands.\textsuperscript{112}

World War II left the former colonial superpowers of Europe weak. It also generated fervor for more political representation and autonomy among Caribbean islanders. France and the Netherlands assented to these demands, retaining their colonies as territories equal to their European counterparts. This arrangement has benefitted the territories greatly, making them some of the most prosperous islands in the Caribbean.\textsuperscript{113} The United Kingdom granted

\textsuperscript{108} Gibson, \textit{Empire’s Crossroads}, 241-255.
\textsuperscript{109} Ibid., 256-258.
\textsuperscript{110} Blouet, \textit{The Contemporary Caribbean}, 47.
\textsuperscript{111} Gibson, \textit{Empire’s Crossroads}, 256-258.
\textsuperscript{112} Ibid., 261-263.
\textsuperscript{113} Blouet, \textit{The Contemporary Caribbean}, 52, 60.
independence to most of its colonies in the 1960s, ‘70s, and ‘80s. Dominica gained independence in 1978. In the context of the Cold War and American hegemony, the newly independent islands struggled to enter the world stage. Independence also posed economic challenges, as islands lost preferential trade arrangements with their former motherlands.\textsuperscript{114} As European nations granted independence to many of their Caribbean holdings, they recognized the dominance of the United States in the region.\textsuperscript{115} The U.S. retained Puerto Rico and initiated Operation Bootstrap in 1947 to promote economic growth. The program, which involved tax incentives and low-interest loans, was successful in spurring economic development, but failed to alleviate high unemployment and poverty. In 1952, Puerto Rico was granted “commonwealth” status and internal autonomy as a “free associated state.”\textsuperscript{116}

The postwar period witnessed the height of American power in the basin. European decolonization and the expansion of America’s military presence during World War II ensured its dominance.\textsuperscript{117} In a bid to counter Soviet power, the U.S., especially through the CIA, guided and indirectly controlled the development of newly independent nations. It promoted aggressive capitalism to counter Soviet sympathies and to prevent other nations from joining Cuba in supporting the U.S.S.R.\textsuperscript{118} Since 2001, America has shifted its focus to the Middle East, reducing its impact in the Caribbean. However, the region’s proximity to the U.S. and its important shipping lanes make the Caribbean of great strategic importance, suggesting continued American involvement.\textsuperscript{119} The scars of World War II, American meddling during the Cold War, and the

\textsuperscript{114} Blouet, \textit{The Contemporary Caribbean}, 59, 85.
\textsuperscript{115} Gibson, \textit{Empire’s Crossroads}, 263-271.
\textsuperscript{116} Blouet, \textit{The Contemporary Caribbean}, 52, 89.
\textsuperscript{117} Ibid., 49.
\textsuperscript{118} Gibson, \textit{Empire’s Crossroads}, 271-306.
\textsuperscript{119} Blouet, \textit{The Contemporary Caribbean}, 50, 61-63.
difficulties of independence have not yet faded from the region and continue to impede further development, harm human wellbeing, and contribute to high vulnerability.

*The Rise of Tourism.* Much like sugar in the colonial period, tourism emerged as the dominant industry in the Caribbean and came to influence nearly all aspects of life in the twentieth century. The rise began at the turn of the century in response to a rehabilitation of the region’s image as a healthy and safe vacation destination.\(^{120}\) At the time, the islands were destinations reserved for the wealthy elite of Europe and North America. Starting in the 1960s, when sugar was still the dominant industry, the middle class flocked to the tropical paradise, leading to a significant expansion in the industry. Island governments were initially wary of tourism and its potential role in economic development. However, facing few alternative options, the region mostly embraced it.\(^{121}\) The World Bank and other institutions endorsed the industry, especially for newly independent nations. However, it did not develop uniformly. While tourism thrived in many of the islands of the Eastern Caribbean, Dominica stands out as an exception. The mountainous volcanic country has few beaches and therefore does not match the sandy paradise stereotype of Caribbean tourism. Moreover, a series of violent attacks and murders of tourists in the 1970s further eroded the island’s appeal.\(^{122}\) However, the majority of the islands developed tourism that now dominates their economies, as is explained in the next chapter.

*Regional Cooperation.* The postwar period also witnessed attempts at regional support in the Eastern Caribbean. In 1968, several islands formed the Caribbean Free Trade Area (CARIFTA). The association, mainly composed of former British colonies, had little impact due to the limited trade between islands. The following year, the Caribbean Development Bank was

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\(^{120}\) Gibson, *Empire’s Crossroads*, 338-339.


\(^{122}\) Gibson, *Empire’s Crossroads*, 340-341.
founded in Barbados. The Caribbean Community (CARICOM), CARIFTA’s successor, was established in 1973 to handle trade issues and foster inter-island cooperation. However, due to the diversity in the region, the group has had little success. In the Eastern Caribbean, it includes all of the former British colonies, but excludes Puerto Rico, the U.S. Virgin Islands, Martinique, and Guadeloupe.\textsuperscript{123} In response to Hurricane Hugo, a Category 4 storm in 1989 that heavily damaged the U.S. Virgin Islands, Puerto Rico, and others in the region, CARICOM formed the Caribbean Disaster Emergency Response Agency (CDERA) in 1991. The CDERA attempted to bolster hurricane preparation and respond to damage, but a lack of resources reduced their effectiveness. Renamed the Caribbean Disaster Emergency Management Agency (CDEMA) in 2005, the CDEMA’s efforts have been expanding in the last decade.\textsuperscript{124}

\textit{Conclusion.} The history of the Eastern Caribbean is a turbulent one, marked by the stains of European imperialism and slavery. Moreover, it is impossible to examine the region’s development without analyzing the impact of its characteristic tropical weather: hurricanes. European colonization began a process of imperialism and subjugation that would continue for hundreds of years. The United States has continued this control in political, economic, military, and cultural forms. As we will see in the next chapter, the Caribbean’s painful history is relevant because of the region’s inability to overcome the scars of imperialism that have proved to be significant impediments to political and economic development. Despite the constant reality of extreme tropical weather, which has played a substantial role in the Caribbean’s history, the events of the past have prevented adequate adaptation to this reality, causing high vulnerability, degrading ecosystem services, and harming human wellbeing. With that in mind, the

\textsuperscript{123} Blouet, \textit{The Contemporary Caribbean}, 71, 96.
\textsuperscript{124} Schwartz, \textit{Sea of Storms}, 278, 315.
contemporary products of this history, the political and economic realities that contribute to vulnerability, can now be examined.

Chapter 3: Politics, Economics, and Vulnerability

The threat hurricanes pose to the Eastern Caribbean is not merely a consequence of location. The region’s geography puts it in the path of these dangerous storms, but the political and economic realities of the individual islands determine the extent of the damage and the speed of recovery. The legacy of imperialism has defined the Eastern Caribbean’s modern economic and political situation. For some islands, this poses the challenges of relatively recent independence; for others, the balance of internal self-governance and territorial relationship to its national government. In general, territories have fared better than their independent neighbors. However, global economic and political forces impact the entire region, regardless of individual island status. The economic stability and political efficacy of the islands, often dependent on the actions and policies of foreign powers, determine vulnerability to hurricanes. The region’s ability to cope with these powerful storms and the damage they inflict is in many ways a measure of its economic and political development.

Hazard, Vulnerability, and Disaster. Hurricanes are formidable forces of nature that often leave disastrous damage in their wake. As a result, they are generally identified as natural disasters. However, scholars have disputed this characterization in recent decades. Instead, many now suggest that the impacts of hurricanes are “disasters with a natural trigger” (for this and following, see citation at end of paragraph). Tania Lopez-Marrero and Ben Wisner provide a useful framework for evaluating hazards, disaster, vulnerability, and risk. They define a hazard as a “potential interaction between a physical event…and a human system.” It is the possibility that a natural trigger, like a hurricane, may impact inhabited land and cause a disaster, “a
situation in which a hazard actually influences a vulnerable human system and has consequences in terms of damage, loss, disruption of activities, or casualties that are of such a magnitude that the affected people do not have the mechanisms to deal effectively with them.” A hurricane causes a disaster when it inflicts severe damage on land, but remains only a hazard in the abstract. Vulnerability is “being susceptible to loss, damage, and injury.” It determines a group’s ability to “anticipate, cope with, resist, and recover from the impact of a disaster.” Finally, risk is “the coincidence of hazard and vulnerability…. Disaster risk combines a hazard’s potential occurrence, magnitude, and frequency with people’s susceptibility to loss, injury, and death.”

The characteristics of disaster play an important role in determining the risk of the Eastern Caribbean. A Category 5 hurricane is usually more devastating than a tropical storm. However, hazards are only one aspect of disasters. Vulnerability determines the extent of the damage hurricanes inflict and the ability of affected areas to recover from the aftermath. In the case of the Eastern Caribbean, economic instability and the resulting political ineffectivity has contributed to a high degree of vulnerability for the region’s inhabitants.

Economics. There are several economic trends in the region that have contributed to high vulnerability, degraded ecosystem services, and harmed human wellbeing. Globalization has had a significant impact on the region’s economy, especially for the small islands of the Lesser Antilles. Free trade has harmed the agricultural sector, the central industry imposed by European colonial powers. The dependence on export agriculture placed the region at a disadvantage in the twentieth century and beyond. The sugar industry still exists but has declined considerably in the contemporary Caribbean. Barbados and Puerto Rico continue to grow sugar, but other islands, such as St. Kitts, have ceased production, turning instead to tourism.126 Stiff competition from

126 Gibson, Empire’s Crossroads, 328-329.
cheaper producers in Central America has contributed to the crop’s decline. However, the collapse of the sugar industry is beneficial. It provided low-paying jobs that required strenuous manual labor, discouraging governments from investing in education. Moreover, social mobility was virtually nonexistent in the industry. Therefore, the decline in sugar both reflects the improvements in quality of life that have already taken place in the region, such as economic diversification, rising incomes, and higher rates of education, and presents an opportunity for further economic development and social improvement.  

In addition to sugar, other crops have suffered from the global move toward free trade. This is especially the case with bananas. The European Union had preferential trade agreements with small Caribbean growers, but Chiquita, the powerful U.S. banana producer, challenged the agreements with the World Trade Organization. The challenge was successful, and the EU eliminated the protections for Caribbean banana producers in 1997. Other trade protections exist from the 1975 Lomé Convention that aimed to promote economic development in the Caribbean and other regions. However, the trend toward free trade and the repeal of these protections spells danger for Caribbean producers, especially in Dominica and some of its neighbors in the Windward Islands. Martinique, where bananas are an important export, has been spared from these repeals, as it is a French territory and therefore part of the EU. This reflects a more general trend in the region in which European territories are stronger economically than independent nations. On other islands, however, small banana farmers who have lost subsidies due to government debt and have to import raw materials cannot compete with cheap Central American bananas produced by large American corporations.

127 Blouet, The Contemporary Caribbean, 83-84.
128 Gibson, Empire’s Crossroads, 329.
129 Blouet, The Contemporary Caribbean, 84-85.
As noted in the previous chapter, domestic food production has not been a priority in the region for most of its modern history. This trend continues today. The World Trade Organization has urged islands to import food from the U.S. and other countries. Cheap, subsidized American food has flooded Caribbean markets and outcompeted the region’s traditional agriculture. In addition to harming food production, the widespread consumption of American products has caused major public health problems with obesity and its linked impacts.\textsuperscript{131} The importation of food and other goods from the U.S. and Europe has contributed to the region’s large trade deficit.\textsuperscript{132} These economic realities have caused high poverty, unemployment, and low standards of living, making people ill-equipped to deal with disaster.\textsuperscript{133} These obstacles to economic development have contributed to the high vulnerability of the region.

Before discussing tourism, the key industry in the modern Caribbean, there are a few other economic activities worth mentioning. Manufacturing has never been a central industry in the Eastern Caribbean, excluding the sugar refinement of the colonial period. However, due to Operation Bootstrap, Puerto Rico has become the most industrialized island in the entire Caribbean. The pharmaceutical industry has expanded there substantially. As discussed in the previous chapter, Operation Bootstrap did little to improve the lives of Puerto Ricans. Moreover, most of the profits from these industries are returned to the mainland United States. Manufacturing is not a major industry in the Lesser Antilles, but most islands manufacture rum for export and domestic use.\textsuperscript{134} However, American companies in Puerto Rico and the U.S Virgin Islands like Bacardi receive subsidies that threaten smaller producers on other islands.\textsuperscript{135}

\textsuperscript{131} Gibson, \textit{Empire’s Crossroads}, 330.  
\textsuperscript{132} Blouet, \textit{The Contemporary Caribbean}, 82.  
\textsuperscript{133} Lopez-Marrero and Wisner, “Not in the Same Boat,” 147.  
\textsuperscript{134} Blouet, \textit{The Contemporary Caribbean}, 88-89.  
\textsuperscript{135} Gibson, \textit{Empire’s Crossroads}, 330.
Another important industry in the region is offshore financial services. Several Caribbean islands provide tax shelters for wealthy Americans and Europeans. The Caymans are the prime example of this industry.\textsuperscript{137} In the Eastern Caribbean, Barbados has greatly benefitted from its financial services sector.\textsuperscript{138} However, the 2008 recession dealt a blow to the industry. The islands have managed to attract a large number of firms to the region with its tax-free policies, but this arrangement has deprived them of critical funds. In response to the problem, some island nations have allowed residents of other countries to purchase citizenship. Dominica offers this opportunity for $100,000. These programs have been especially popular among people from Middle Eastern countries facing political and economic instability. The United States is wary of this economic citizenship and its implications for terrorism.\textsuperscript{139}

\textsuperscript{137} Gibson, \textit{The Contemporary Caribbean}, 327.
\textsuperscript{138} Blouet, \textit{The Contemporary Caribbean}, 76.
\textsuperscript{139} Gibson, \textit{Empire’s Crossroads}, 328.
Tourism. With the decline of agriculture, tourism has become the dominant industry in the Eastern Caribbean. It generally takes two forms: resorts and cruises. The former is more lucrative for the region, as tourists spend more time, and therefore money, on individual islands. In 2012, 18 million people stayed in the Greater Caribbean and 17 million cruise ship passengers visited. These tourists spent $27 billion. In St. Lucia, Antigua-Barbuda, Anguilla, and the U.S. Virgin Islands, the tourism sector generally makes up over 50% of GDP annually. Generally, all-inclusive resorts are the norm in the Eastern Caribbean. Poor infrastructure and public transportation severely limit independent travel. Moreover, air and sea connections among the islands are sparse, making regional travel difficult. All-inclusive resorts allow tourists to stay in one location for the duration of their visit.

The tourism industry capitalizes on the natural beauty of the islands, an example of their cultural ecosystem services. Eco-tourism has monetized beaches, snorkeling, water sports, and other leisure activities. Dominica has especially embraced eco-tourism. As mentioned in the previous chapter, the island lacks the sandy beaches of its neighbors that draw so many people to the region. The country has avoided the development of all-inclusive resorts and instead advertises the natural beauty of its forested, mountainous landscape.

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141 Lopez-Marrero and Wisner, “Not in the Same Boat,” 151.
144 Gibson, *Empire’s Crossroads*, 344.
The benefits of tourism come at a price. Despite the region’s attention and effort to developing the industry sustainably, there are environmental consequences, such as beach erosion and ocean pollution. These are especially concerning since the draw of the islands is their natural beauty. If the cultural ecosystem services upon which eco-tourism rely are degraded, the industry will collapse. The movement to protect these resources for tourists has barred locals from accessing them. Moreover, the destruction of coastal regulating services contributes to the islands’ vulnerability. As noted in Chapter 1, sand dunes are a vital coastal defense, so beach erosion poses a serious threat. Other environmental problems include the depletion of a limited supply of freshwater, especially on the smaller islands of the Lesser Antilles, and the reliance on imported food and other supplies to support the industry. This degradation of cultural,  

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146 Blouet, The Contemporary Caribbean, 92-94.  
148 Gibson, Empire’s Crossroads, 344.
regulating, and provisioning services reduces the islands’ resilience to storms and their underlying economic security.

There are various economic costs to tourism as well. Its dominance makes the region dependent on wealthy developed nations. Economic downturns in the United States, Canada, and Europe where most tourists reside reduce travel to the Eastern Caribbean and cut into profits. The threat of hurricanes adds to this instability, as major storms can destroy resorts and cripple the industry.\textsuperscript{149} Even when business is booming and the weather is clear, most of the money generated does not stay in the region. Foreign corporations own the majority of resorts, control the industry, and remove profits from the islands. Island residents work in the resorts for low wages. The money that does fall into the hands of locals and governments is used to purchase imported food and other goods from the United States and Europe.\textsuperscript{150} Therefore, while the tourism industry has prevented an economic collapse in the Eastern Caribbean, it is not sufficient to encourage economic development.

The suffering agricultural sector and the dominance of tourism have contributed to poverty and unemployment, causing low standards of living and making people ill-equipped to deal with disaster. High levels of poverty prevent individuals from taking small-scale action against storms, including the purchase of insurance or home improvements that can provide protection against flooding. In the public sphere, the lack of public funds stemming from foreign control of the tourism industry and general poverty hinder the abilities of government to bolster hurricane defense, take preparatory action before storms, and offer relief in their wake.\textsuperscript{151} Thus, the economic situation of the Eastern Caribbean has contributed to its high vulnerability.

\textsuperscript{149} Lopez-Marrero and Wisner, “Not in the Same Boat,” 151.
\textsuperscript{150} Blouet, \textit{The Contemporary Caribbean}, 92-94.
\textsuperscript{151} Lopez-Marrero and Wisner, “Not in the Same Boat,” 147.
Politics. Unlike their neighbors to the west, the nations and territories of the Eastern Caribbean have relatively stable, democratic governments. Naturally, the political situation of independent island nations is distinct from that of dependent territories. From North to South, these countries include Antigua-Barbuda, St. Kitts-Nevis, Dominica, St. Lucia, and Barbados. All of these countries are former British colonies and part of the Commonwealth of Nations. As noted earlier, economic benefits for former colonies have declined in recent decades. However, membership in the Commonwealth provides some apparent benefits. In the wake of Hurricane Maria, the UK gave £62 million to support the region’s recovery. While most of these funds were distributed to British territories, £5 million was given to Dominica.

When these island nations became independent in the late twentieth century, they developed parliamentary democracies, the government of their former colonial power. While this style of government has provided stability and smooth transfers of power, an elite class isolated from the common people and aloof from the problems facing the majority of their constituents controls governments. As a result, law and order prevail, but unemployment and poverty abound.

Debt also prohibits the governments of many of these countries from functioning effectively. Several nations have debt greater than their GDPs, including Saint Kitts and Nevis and even relatively prosperous Barbados. Without the financial support of their former colonizers, many countries in the region borrow money from the World Bank and the International Monetary Fund to foster development. However, these global institutions attach

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155 Gibson, Empire’s Crossroads, 311, 314-315.
strict stipulations to their loans. Requirements include the reduction of government spending, which hinders investment in infrastructure, education, healthcare, and other public services that can spur economic development. As a result, these governments have found themselves in debt with little to show for it. They allocate a large portion of their budgets to debt repayments. Thus, governments cannot spend to stimulate economic development, improve infrastructure, or otherwise address their vulnerability. Political inefficacy is in many ways an economic problem.

Dominica is a unique case in the Eastern Caribbean, not because of its political system, but ambitions. As a former British colony, it has a parliamentary government led by Prime Minister Roosevelt Skerrit, who has been in power since 2004. In the most recent election on December 6, 2019, Skerrit’s Dominica Labour Party easily won its “unprecedented fifth term” with 18 of 21 legislative seats. The election was marred with weeks of protests and calls for electoral reform that required domestic and international security forces to monitor voting. Nevertheless, no serious unrest has been reported, suggesting the maintenance of democracy and political stability. As noted in Chapter 1, Skerrit declared that Dominica would be the world’s first climate-resilient country. The government has published a comprehensive plan laying out principles and goals for 2030. The plan defines seven development objectives, including promotion of ecosystem, infrastructure, and economic resilience, improvements in food security and sustainable resource use, and the expansion of social services and risk assessment. The ambitious plan displays strong political will for adaptation to climate change.

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156 Lopez-Marrero and Wisner, “Not in the Same Boat,” 147.
159 Dominica, National Resilience Development Strategy, 8.
and hurricane risk. Whether Dominica can overcome the economic challenges outlined above remains to be seen.

Dominica is also of special interest in this discussion because of its ties to China, which has loaned the country $14 million to construct its State House and Dominica State College. China has also promised the country millions in aid. In return, Prime Minister Skerrit ended relations with Taiwan in 2004. Dominica’s relationship with China reflects a broader trend in the region. The country has promised $1 billion in loans to the entire Caribbean, donated $1 million to the Caribbean Community (CARICOM) Development Fund, and invested hundreds of millions of dollars in the islands. Some of China’s interest in the region can be explained by resources like timber, but its proximity to the U.S. and many of the islands’ recognition of Taiwan are also likely factors. In the Eastern Caribbean, Barbados and Antigua and Barbuda are also involved with China, which has influence in islands throughout the region.\textsuperscript{160}

\textsuperscript{160} Gibson, \textit{Empire’s Crossroads}, 322-323.
Island Territories. Dependent territories face similar political and economic problems as their independent neighbors because they are autonomous. However, they have the economic and political support of their mother countries, which at least in theory, would make them stronger and less vulnerable to disaster. In practice, the results have been mixed, with some territories flourishing while others have faltered. They include the former French colonies of Martinique and Guadeloupe. These islands are now départements with equal standing to the départements in continental France. Inhabitants are French citizens. As noted earlier, their relationship to France has allowed them to surpass their independent counterparts economically because of their access

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to EU subsidies and markets.\textsuperscript{162} The Netherlands also has territories in the region, including Saba, Sint Maarten, and Sint Eustatius.\textsuperscript{163}

There are also several British territories in the region, including the British Virgin Islands, Anguilla, and Montserrat. These islands were generally seen as too small and weak for independence, resulting in their territorial status.\textsuperscript{164} As described in the previous section, the United Kingdom provided substantial relief to its territories in the wake of Hurricane Maria. In 2018, the House of Commons Foreign Affairs Committee published a report on the UK’s emergency response and provided recommendations for future relief efforts.\textsuperscript{165}

The largest and only island of the Greater Antilles discussed in this paper, Puerto Rico, and the U.S. Virgin Islands are territories of the United States.\textsuperscript{166} Unlike its French neighbors, Puerto Rico does not enjoy sizable subsidies from the mainland. Operation Bootstrap did little to alleviate the island’s problems. In 2012, 45.6\% of Puerto Ricans lived in poverty, compared to 26.6\% in Mississippi, the country’s poorest state. The island also suffers from rampant crime and one of the highest murder rates in the world.\textsuperscript{167} The United States’ neglect of its territory has become painfully clear in the wake of Hurricane Maria. The glacial response, noted in the Introduction, and the trauma survivors experienced from the lack of relief display the failure of the U.S. to adequately attend to its territory.\textsuperscript{168}

\textit{Regional and International Attempts to Reduce Vulnerability.} The previous chapter describes several of the regional initiatives and agencies that formed in the Caribbean after

\textsuperscript{162} Blouet, \textit{The Contemporary Caribbean}, 65.
\textsuperscript{163} Gibson, \textit{Empire’s Crossroads}, 316.
\textsuperscript{164} Blouet, \textit{The Contemporary Caribbean}, 66.
\textsuperscript{166} Blouet, \textit{The Contemporary Caribbean}, 64.
\textsuperscript{167} Gibson, \textit{Empire’s Crossroads}, 314-315.
\textsuperscript{168} Appendix.
World War II. The Caribbean Community (CARICOM), the association created to handle trade and regional economic issues, has struggled to meet its goals due to the political, economic, and cultural diversity in the region.\textsuperscript{169} The Caribbean Disaster Emergency Management Agency (CDEMA) initially accomplished little in reducing the region’s vulnerability to hurricanes. The CDEMA’s efforts have been expanding in the last decade, suggesting that it could become a vital resource for hurricane relief in the future.\textsuperscript{170}

The global community has also begun to recognize the crisis of climate change and the severe impacts it will have in the developing world, include the SIDS of the Eastern Caribbean. This is evident in the first international climate change agreement, the 1997 Kyoto Protocol. One of its programs included the Clean Development Mechanism (CDM), which allowed developed nations to earn emission credits by funding mitigative projects in developing countries.\textsuperscript{171} In a 2010 report, the World Bank described the CDM as more successful than initially anticipated and a vital market mechanism for future climate action. However, it also cited operational shortcomings, design flaws that excluded transportation and forest management from eligibility, and high costs that necessitate its reform.\textsuperscript{172} Another Kyoto mechanism, the Adaptation Fund, was designed to finance adaptation projects in developing nations.\textsuperscript{173} Despite its promise, the

\begin{itemize}
  \item \textsuperscript{169} Blouet, \textit{The Contemporary Caribbean}, 96.
  \item \textsuperscript{170} Schwartz, \textit{Sea of Storms}, 278, 315.
\end{itemize}
World Bank reported that its tax on mitigation, which is a beneficial action, works to disincentivize emission reduction and creates deadweight losses.174

The 2015 Paris Agreement, successor to the Kyoto Protocol, expresses an explicit commitment of developed nations to assisting those less able to adapt to the consequences of climate change. Specifically, it declares that developing nations, including SIDS, are more vulnerable to the effects of climate change and require international support.175 Therefore, developed nations should provide financial and other forms of support to these nations for adaptation to these consequences.176 Article 6 of the Paris Agreement also provides a provision of an unnamed mechanism to promote international cooperation in greenhouse gas mitigation and sustainable development.177 This mechanism has great potential to assist the Eastern Caribbean. It may refer to the creation of a carbon market and could perhaps incorporate the CDM and Adaptation Fund programs of the Kyoto Protocol. These agreements are hopeful signs that the international community will assist the Eastern Caribbean in reducing its vulnerability.

However, the economic plight of the region due to harmful free trade policies and the U.S. withdrawal from the Paris Agreement raise doubts about the efficacy of these plans.178

Conclusion. The economic and political situation of the Eastern Caribbean has resulted in a high degree of vulnerability to hurricanes. The legacy of European colonialism, especially the historically undiversified agricultural economy and the subsequent reliance on tourism, has hindered the region’s economic stability. Moreover, globalization has prevented the islands from competing in world markets. The turn to tourism has sustained the region’s economy but has

176 Ibid., 9.1-4.
177 Ibid., 6.4.
failed to secure broad prosperity. High rates of poverty and unemployment hinder individuals from investing in more immediate protections against hurricanes. Governments are stable but saddled with debt and weak economies. They are unable to invest in infrastructure that would protect against hurricanes and allow for comprehensive responses in the wake of disaster. International agreements like the Kyoto Protocol and the Paris Agreement provide some hope for the region, but little has been accomplished to date. The confluence of these factors has resulted in high vulnerability to hurricanes. The role of colonial and developed powers in this political and economic vulnerability raises several ethical questions, which we turn to now.

**Chapter 4. Unjust Distribution of Climate Consequences**

The Eastern Caribbean’s vulnerability is in large part determined by agents and factors far outside of its control. Most obviously, hurricanes are meteorological realities that humans cannot directly influence. However, the collective actions of individuals, governments, corporations, and other political and economic institutions across the world have contributed to and perpetuate the region’s vulnerability. As seen in the previous chapter, the economic problems and resultant political inefficacy are both products of colonialism and global economic practices. In addition, climate change causes and exacerbates ecological aspects of vulnerability as more powerful hurricanes and higher sea levels threaten the region. Humans are responsible this degradation of ecosystem services, but the blame is not shared equally. The inhabitants of the Eastern Caribbean emit few greenhouse gases, especially compared to the world’s superpowers. Yet, the region bears a disproportionately large share of the consequences. This climate injustice is deeply tied up in colonial institutions. The countries responsible for the region’s vulnerability due to its political, economic, and ecological realities, in partnership with
the inhabitants of the region, have an ethical obligation to lessen this vulnerability through development assistance and climate change adaptation.

*Environmental Justice.* The concept of environmental justice covers several issues at the intersection of environmentalism and social justice. In the context of the Caribbean, distributive environmental justice is most relevant. It concerns the distribution of “environmental benefits and burdens…across populations.”"\(^{179}\) In the Eastern Caribbean, benefits include natural capital and ecosystem services, such as the regulating services of intact beaches and coastal sand dunes, the provisioning services of clean water, and the cultural services of healthy ecosystems and recreation. Burdens may refer to pollution, unsafe environmental conditions, and lack of access to clean environments.

The environmental justice movement has become an important factor in the global shift toward sustainable development. It is “an informal designation that is commonly applied to the international body of theory and practice that has grown up around this concept [of environmental justice].”\(^{180}\) On the global scale, the movement arose in the 1970s and has incorporated colonialism and economic globalization, issues covered in the previous two chapters. Tensions have arisen between developed nations, which are primarily responsible for the global environmental degradation that enabled their development, and developing nations, which resist restrictions on future economic growth and resource use.\(^{181}\) Some of this tension is visible in the Caribbean, especially where environmental initiatives conflict with the interests of

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\(^{180}\) Ibid., 341.

\(^{181}\) Ibid., 346.
inhabitants. For example, in Puerto Rico, locals oppose fishing restrictions.\textsuperscript{182} However, as seen in Dominica’s ambitions to become the first climate resilient nation in the world, there is support for the environmental justice movement in the Eastern Caribbean.

The Caribbean environmental justice movement gained steam in the 1980s, especially in response to the 1988 Brundtland Commission Report and the 1992 UN Conference on Environment and Development. Both the report and the conference aimed to resolve the opposing demands of economic development with environmental stewardship. The movement has largely been led by non-governmental organizations (NGOs).\textsuperscript{183} It is not uniform and reflects the diversity of the islands it covers. However, there are several common strands of the movement throughout the region. The main focus is on conservation of natural resources and ecosystems, especially to meet the threat of the expanding tourism industry.\textsuperscript{184} Due to the political, economic, and geographic differences among the islands, there is also very little regional cooperation, which is a major obstacle to success.\textsuperscript{185} Other important characteristics of the movement include the need for grassroots action, collaboration among locals, NGOs, and elites, and the maintenance of access to ecosystems and their services for citizens.\textsuperscript{186}

\textit{Environmental Justice, Colonialism, and Climate Change}. In the Eastern Caribbean, environmental justice is closely connected to colonialism. This is evident from the previous two chapters, which outline the residual political and economic impacts of colonialism, as well as the global policies and trends that have been enacted by former colonial powers. Another less obvious strand of colonialism in the region is its reliance on tourism. Chapter 3 explains the

\textsuperscript{183} Baver and Lynch, \textit{Beyond Sun and Sand}, 4, 9-10.
\textsuperscript{184} Ibid., 24-25.
\textsuperscript{185} Lynch, “Caribbean,” 131.
\textsuperscript{186} Baver and Lynch, \textit{Beyond Sun and Sand}, 14-15.
industry’s negative environmental and economic impacts. In many ways, these consequences mirror those of colonial domination. Tourism depletes scarce natural resources, threatens the integrity of island ecosystems, and encourages low wages. Moreover, as seen in the previous chapter, it sequesters coastal and forest ecosystems for eco-tourism. This arrangement functions as a new form of economic and ecological colonialism, in which the Eastern Caribbean is subordinated to the control of foreign powers.

Climate change is also an integral component in any discussion of environmental justice in the Caribbean. Climate justice recognizes that climate change does not affect people equally. In terms of distributive justice, the harms are much more concentrated in poor and vulnerable communities. The movement is also concerned with the role of historical injustice and contemporary economic and political systems in vulnerability, the agents behind such unjust structures, the involvement of local governments in mitigation and adaptation decision-making, and sensitivity to local conditions and communities.

The concerns of the climate justice movement make it invaluable in understanding the ethical dimensions of the Eastern Caribbean’s vulnerability, as well as accountability for the states and institutions responsible for such vulnerability. As shown in the first chapter, climate change may be strengthening hurricanes and is almost certainly exacerbating their consequences, endangering ecosystem services and human wellbeing in the Eastern Caribbean. However, as seen in Chapter 1, this region is not a major contributor to climate change. The greatest emitters are the wealthy, powerful countries that have the resources to adapt. In contrast, Chapter 3 illustrates that the Eastern Caribbean struggles to meet the needs of its inhabitants and is unable

to implement sophisticated techniques of adaptation to sea level rise and hurricanes. As a result, the big emitters thrive economically and maintain the means to adapt to climate change in the future, while the Eastern Caribbean has few options to deal with worsening hurricanes.

It is clear that colonialism and climate change are two of the major drivers behind the Eastern Caribbean’s vulnerability. In many ways, climate change is another form of colonialism. Scholar Kyle Powys Whyte writes that “climate injustice is a recent episode of a cyclical history of colonialism inflicting anthropogenic change on Indigenous peoples.” Although Indigenous peoples in the Caribbean were mostly killed in the process of European colonization, Whyte’s characterization of climate injustice is relevant to the Eastern Caribbean for several reasons. Chapter 2 explains that colonization involved inflicting “burdensome anthropogenic environmental change.” Deforestation, the sugar economy, and coastal settlement patterns that destroyed natural protections are examples. Moreover, while African slaves were not Indigenous, they were forcibly brought to the islands. Whyte cites how forced Indigenous relocation was a form of environmental change imposed by colonizers. In addition, he describes how colonists inflicted these changes to enable resource extraction and “carbon-intensive economic activities.” The parallel to the colonial sugar economy and modern tourism is clear. The connection is cemented by the fact that the colonial powers who inflicted these changes are the same ones that have caused climate change.

Whyte’s theory provides guidance in holding colonial powers accountable for much of the Eastern Caribbean’s vulnerability. He rejects the “bad luck view,” which states that

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190 Ibid., 5.

191 Ibid., 6.

192 Ibid., 9.
developing nations and the global poor are more vulnerable to climate change because of the unfortunate confluence of their geographic locations, economic situations, and colonial histories. This understanding distances developed nations and former colonizers from any culpability and is reflected in the UN Millennium Development Goals, which point to poverty in individual nations as the primary cause of their environmental problems. With the understanding of colonialism as burdensome environmental change, it becomes clear that the Eastern Caribbean’s vulnerability is not happenstance. Coastal settlement and the loss of regulating services in the form of sand dune destruction and deforestation have changed the geographies of the islands and increased their hurricane risk. Likewise, their economic situations are the products of colonial agriculture, modern tourism, and global forces. Finally, climate change itself is the result of polluting colonial powers. With this framework, it becomes clear that these powers are at least partly responsible for the region’s vulnerability.

**Ethical Responsibilities of the Global Community.** The Eastern Caribbean’s struggles with colonialism and climate change raise issues of accountability and reparation. In the case of past imperialism, what do former colonial powers owe their colonies? Political scientist Catherine Lu argues these powers have a “political responsibility” that “include[s] the elimination of social disadvantages that identifiable victims may suffer as a result of past injustice.” Political responsibility differs from “moral culpability” in that agents are not blameworthy for the unjust actions of their ancestors, but have a responsibility to amend the unjust structures created by these actions. Lu’s structural understanding also assigns political responsibility to all colonizers who contributed to the international norm of colonialism and

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therefore indirectly impacted the colonized. According to Lu, these countries “bear responsibilities to reform their activities, practices, and institutions to prevent the reproduction of similarly unjust outcomes.”  

In the context of the Eastern Caribbean, Lu’s model for colonial reparations suggests a series of obligations developed nations have to the region. The powers that have directly colonized the islands, including Spain, the United Kingdom, France, the Netherlands, and the United States clearly have political responsibility. Some of the consequences of the colonial period include coastal development and deforestation, suggesting that the former colonial powers should offer assistance in rehabilitating these ecosystems. This is especially true for territories in the region, which demand more stringent obligations.

Lu’s framework can also be applied to economic forces at play that keep the Eastern Caribbean dependent on the tourism industry controlled by foreign companies. The United States, the EU, and other superpowers have a responsibility to amend these structural injustices involving tourism, World Bank loans, and preferential trade agreements that depress the islands’ economies and prevent them from addressing their vulnerability. This obligation is perhaps more binding due to the fact that developed nations not only inherited these structural injustices from their ancestors, but actively perpetuate, expand, and participate in them.

Lu’s model also applies to climate change, which is intimately tied to colonialism. The major greenhouse gas emitters have a responsibility to mitigate their emissions and prevent further climate change. However, because some of the effects will be unavoidable, these nations also have a responsibility to assist the Eastern Caribbean in adapting to the changes they have caused. Due to Lu’s structural understanding, all nations that helped create or perpetuate the

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196 Lu, “Colonialism as Structural Injustice,” 277-278.
above unjust structures have a responsibility, albeit lesser in extent, to dismantle them.

Philosopher Chris Cuomo concurs, arguing that nations “causally responsible for climate change and also quite able to do their parts to address the problem” have obligations to “take responsibility for addressing climate change.” However, Cuomo tempers the obligation, limiting it to nations “quite able to do their parts.” In the context of climate change, where mitigation is crucial, the burden of adaptation assistance for developing nations falls to countries with more resources, such as the U.S. and members of the EU. Therefore, emitters capable of providing assistance have an obligation to help the countries and territories of the Eastern Caribbean adapt to the new reality of hurricanes strengthened by climate change.

*International Recognition of Responsibility.* The developed world has taken steps in recognizing its responsibility for mitigating the Eastern Caribbean’s vulnerability. In 1948, the UN “reaffirmed their faith in fundamental human rights, in the dignity of the human person…and determined to promote social progress and better standards of life.” As a clear sign of this affirmation, the UN recognized a series of rights all humans possess. These include the “right to life, liberty and security of person.” More specifically, this means that, “Everyone has the right to a standard of living adequate for the health and well-being of himself and his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of…lack of livelihood to circumstances beyond his control.” In 2015, the UN Office of the High Commissioner for Human Rights interpreted these rights, including life, development, water, and sanitation, among others, in the context of climate change.

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200 Ibid., 25.1.
change. Moreover, the office asserted the responsibility of countries to promote “sustainable, human rights-based development” and ensure all people have the resources to adapt to climate change’s consequences.\textsuperscript{201} One of the UN Millennium Development Goals is to “ensure environmental sustainability,” which includes ecosystem and resource protections and the expansion of clean water and access to sanitation.\textsuperscript{202} As noted in the previous chapter, the Paris Agreement echoes these obligations.

Despite such lofty declarations, the global community does not guarantee all of the aforementioned rights to hurricane victims in the Eastern Caribbean. The destruction left by these storms robs people of key provisioning services, such as food, water, housing, medical care, and many other basic necessities. These conditions often lead to death. Some of these rights violations are inevitable, as it would be very difficult, if not impossible, to completely eliminate hurricane vulnerability. However, as seen in the previous chapters, the Eastern Caribbean is unacceptably vulnerable because of the actions of former colonial powers and modern economic and political policies. Therefore, former colonizing nations and modern global superpowers that contribute to this vulnerability are failing in their recognized obligations.

*Responsibility of the Eastern Caribbean.* While much of the responsibility for the Eastern Caribbean’s vulnerability lies with forces outside its control, the region cannot and should not rely solely on foreign assistance. First, not all of the inhabitants are entirely blameless for their vulnerability. Lu’s framework helps to shed light on this. She describes how the colonized contribute to or perpetuate structural injustice.\textsuperscript{203} As noted in Chapter 3, the governments of the

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\textsuperscript{203} Lu, “Colonialism as Structural Injustice,” 263, 270.
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Eastern Caribbean are stable but controlled by elites out of touch with the problems facing the islands. Exceptions may include Dominica, with its ambitious plan to become climate resilient, and Barbados, with its welfare system and large middle class.\textsuperscript{204} However, there remains a responsibility for elites to dismantle unjust structures, from which they may benefit, and collaborate with local communities and foreign leaders to reduce vulnerability. Another important component of this is regional collaboration, which, as described above, has been sorely lacking. Thus, elites have a responsibility to coordinate strategies across islands.

The history and current situation of the Eastern Caribbean does not suggest a willingness on the part of elites to enact comprehensive structural reform. Thus, inhabitants of the region seem to have an ethical responsibility to pressure their leaders into action. Indeed, political scientist Sherrie Baver and sociologist Barbara Deutsch Lynch report that, “Without a well-organized and cohesive push from the bottom, change at the top is unlikely.”\textsuperscript{205} However, the islanders’ ability to engage in grassroots community-based action is questionable and likely varies across social classes. Such action may pose an undue burden. The precarity of most people in the Eastern Caribbean illustrates the need for elites to take the lead in reform, while also attuning themselves to the needs and concerns of local communities.

\textit{Conclusion.} In light of the causes of the Eastern Caribbean’s vulnerability, it is clear that certain actors have ethical obligations to protect the human rights of the region’s inhabitants because of current actions and historical wrongs that contribute to modern suffering. The UN Declaration of Human Rights affirms the dignity of the people of the Eastern Caribbean and requires developed nations to ensure that dignity is respected. The Millennium Development Goals and Paris Agreement concur. Given the histories of imperialism, globalization, greenhouse

\textsuperscript{204} Gibson, \textit{Empire’s Crossroads}, 311.
gas production, and climate change, the developed world has an ethical obligation to reduce the vulnerability it has caused by stimulating the region’s economy and providing aid in hurricane and climate change adaptation. With these obligations established, we can now turn to policy recommendations.

Chapter 5. Securing a Future for the Eastern Caribbean

The Eastern Caribbean faces significant challenges in addressing its vulnerability to hurricanes and climate change. As seen in the first chapter, hurricanes and the damage they inflict are becoming worse. This trend will only continue in the future. The region must reduce its vulnerability to the new stormy reality it faces through adaptative technology and economic programs that promote reconstruction and smart development. However, hurricanes in the recent past have shown that the region is unable to effectively make such changes. The current economic and political trajectory of the islands does not provide much hope for the future. Therefore, if the rights of the Eastern Caribbean’s inhabitants are to be protected and their livelihoods ensured, the region’s inhabitants and the global community must take action. In light of the ethical obligations laid out in the previous chapter, the developed world must play an active role in reducing the region’s vulnerability, protecting its ecosystem services, and bolstering it against powerful hurricanes.

Coastal Design Strategies. As mentioned in Chapter 1, there are numerous design strategies that can be implemented to reduce coastal vulnerability. Arguably the most effective and sustainable solution is the maintenance of sand dunes. In areas where dunes exist, they should be protected. Dune grasses are essential to stabilizing the sand but are highly susceptible to trampling. Therefore, dunes must be closed off to public use. Pedestrian bridges can provide beach access while causing minimal damage to grasses. It is important not to cut walkways
through dunes, as these act as channels for surge during storms. Moreover, resorts should be built behind existing dunes. This building pattern maintains vital coastal defense and protects the investments of the tourism industry. If dunes have been destroyed, they should be reconstructed in areas where possible. Project managers should obtain sand dredged from the open ocean to protect fish nurseries, coral reefs, and dunes in other locations.

Unfortunately, many of the sand dunes in the region have been destroyed and cannot be reconstructed. As noted in Chapter 2, European colonizers built coastal settlements to facilitate ocean trade. Moreover, sand dunes are popular locations for resorts, as they provide close beach access and ocean views. In heavily developed coastal areas, hard-protect, gray strategies, like seawalls, are often the most effective structures. They require considerable maintenance but take up minimal space and can be multifunctional. Seawalls should be integrated into their surrounding landscape as much as possible. Optimal uses include public walkways, parks, and roads. Parks behind seawalls provide extra protection when floodwaters breach, especially if they are built at a lower elevation than the development behind them. In addition to seawalls, breakwaters can be built offshore to reduce wave action. Therefore, in areas where sand dunes are not a feasible option, large seawalls should be built and maintained. Buffers, such as public parks and walkways, should separate development from seawalls with as much space as possible to mitigate flood damage.

In addition to storm surge, Chapter 1 discusses the potential damage torrential rain can cause in hurricanes and the store design strategies that can mitigate this threat. They involve building areas that can temporarily store rainwater or surge during a storm event. The buffers mentioned in the previous paragraph are an example. Another type of store strategy includes green infrastructure, such as permeable pavement and the addition of greenspace in urban areas
to encourage rainwater infiltration. These strategies are generally more suited to urban areas where much of the ground is hardscape. Finally, inland floodable areas, which can be parks or plazas that are lower in elevation than the surrounding development, can accommodate storm water during flooding. These strategies should be implemented in cities and other highly developed areas. Chapter 2 also outlines the deforestation that occurred on the islands to enable the sugar economy. As agriculture is declining in the region, restoration of forests should be a priority. These areas can absorb rainwater and reduce flooding, as well as provide cultural ecosystem services for locals and eco-tourism opportunities.

The final type of design strategy, retreat, is the most controversial and challenging. It reimagines destruction from storms and rising sea levels as an opportunity to build greater resiliency. In the wake of disaster, islands should not rebuild in destroyed areas adjacent to the water. Instead, they should move development inland to higher ground where it will face less damage in future events. The land near the coast can then be developed into parks, walkways, or sand dunes that can provide protection in storms. The differing geographies of the islands discussed in Chapter 1 present challenges to this strategy. It is less feasible for the mountainous islands of the western Lesser Antilles, although the elevation gained by moving inland is greater. However, it is well suited to Puerto Rico, which is much larger and also has a central mountain range that can provide elevation. The eastern Lesser Antilles are low-lying, facilitating inland development, but their small size raises the issue of space.

Retreat is the most effective and permanent option for coastal protection. It is an excellent design strategy in the aftermath of major storms and should inform rebuilding efforts. In the meantime, the islands of the Eastern Caribbean should protect and rebuild sand dunes wherever possible. In other locations, they should build and maintain seawalls, create buffer
zones near the coast, and promote rainwater infiltration and storage with green infrastructure and forest restoration. These design strategies will mitigate hurricane impacts.

*Local and Regional Policies.* Islands can incentivize the above design features with political strategies. For example, governments should subsidize relocation for people in vulnerable coastal areas. This strategy can enable retreat prior to the arrival of storms, preventing harms to human wellbeing. The islands can then purchase coastal land and restore sand dunes or build protective structures. To address beach resorts, governments should levy higher taxes on buildings within a certain distance from the intertidal zone to encourage construction behind sand dunes and outlaw dune destruction. Local and national governments should also enact more stringent building codes for resorts and private dwellings to increase protection against flooding and high winds.

Islands should also draw up resiliency plans, such as Dominica’s, specific to their geographic, political, and economic situations. These plans should include risk assessment of local communities, the creation of early warning systems, the construction of hurricane-resistant shelters, goals to reduce drivers of vulnerability, such as poverty and access to sanitation, and strategies to achieve these goals. Some strategies may include the creation of a social welfare system, subsidies for home improvements to protect against flooding and wind damage, and infrastructure upgrades.

Regional cooperation is also crucial to reducing vulnerability. Chapter 3 discusses some of the regional agencies that function in the Caribbean, including CARICOM and CDEMA. These organizations have great potential but are currently struggling. CDEMA should continue to expand its efforts to prepare islands for hurricanes and offer relief in their aftermath. It should also establish an inter-island evacuation system. Since hurricanes rarely hit every island in the
region, such a system could provide an emergency last-resort option. Even on islands with smaller populations where evacuation is more feasible, it is likely not realistic to evacuate an entire island. However, the system could be used to bring the most vulnerable people to emergency shelters in other parts of the Eastern Caribbean. Due to expense and logistical challenges, this system should only be used in dire emergencies.

*Economic Streamlining and “Caribbeanization.”* The strategies outlined above are expensive. If the Eastern Caribbean is to successfully adapt to the new reality of powerful hurricanes, the island governments must have the resources to prepare before storms, invest in infrastructure, and deal with the aftermath. Chapter 3 describes how the tourism industry, controlled by foreign companies, dominates the region. To solve these issues, the region must integrate and diversify its economy. As seen in the third chapter, the Eastern Caribbean has a large trade deficit, as it must import food and other goods, mainly to fuel tourism. After the collapse of the sugar industry, the cultivation of other crops did not arise. Food grown in the Eastern Caribbean cannot compete in global markets, but it can within the region. The islands should use their arable land, formally used for sugar, to grow food for their resorts, rather than importing that food. The region should also develop and modify minor manufacturing industries based on individual islands’ resources to produce goods for resorts and lower the trade deficit. Governments should not allow widespread manufacturing, as, described in Chapters 2 and 3, this trend in Puerto Rico has not reduced vulnerability or poverty. Small-scale production of goods for local consumption, such as rum, however, may be beneficial. Tariffs to protect the local manufacturing industry may be required.

Streamlining industries to support tourism will lower imports, but still renders the Eastern Caribbean dependent on the developed world. Chapter 4 characterizes this dependency and the
tourism industry as a new form of unjust colonialism. For that reason, the islands must “Caribbeanize” tourism. This can be accomplished through taxes on foreign corporations and subsidizing local tourism companies. CARICOM is important here. If only a few islands raise taxes, tourism will likely decline, and the industry will shift toward other business-friendly islands, resulting in a race to the bottom. Therefore, the region must present a united front. If the islands impose uniform taxes, they will benefit from increased revenue and retain the industry. For this reason, CARICOM should include all islands in the Caribbean.

Governments in the Eastern Caribbean should also encourage and invest in locally owned resorts and excursion companies related to eco-tourism. If local entrepreneurs owned and operated more businesses in the tourism sector, more of the money would remain in the region and would stimulate economic growth. Islands should exercise caution with eco-tourism, as it can degrade natural resources and cut off access to locals. Therefore, any development of eco-tourism must ensure access to ecosystem services for inhabitants and earmark some part of tax revenue for environmental preservation. Levying taxes on foreign companies’ use of ecosystems may support these goals. Individual countries and territories should also invest in local and regional infrastructure and transportation to reduce the need for all-inclusive resorts. The expansion of intra-regional travel of tourists will provide new opportunities for local businesses to benefit from the industry.

The tourism policies outlined above will mitigate the neocolonial features of tourism but will not reduce the Eastern Caribbean’s dependence on the industry. Unfortunately, there is little the region can do to shake this dependence. However, it can diversify its economy to a limited extent. Chapter 3 explains the rise of offshore financial services in the region. Barbados serves as a model for the benefits of expanding this industry, which can be highly lucrative. However, it is
very sensitive to changes in the global economy and is another form of dependence on the developed world. Islands seeking to invest in offshore services should do so with caution.

*Global Economic Policy*. Chapter 3 describes how global economic policies and trends have had negative impacts on the Eastern Caribbean. Indeed, many of the policy recommendations above would be struck down by the World Trade Organization because they interfere with free trade. In order for islands to use locally grown food for resorts and local consumption, governments must enact tariffs on cheaper imported food. The WTO is controlled by developed nations and former colonial powers. Allowing these tariffs is part of their obligation described in Chapter 4 to dismantle structural injustices and promote economic growth and development in the region. Moreover, it is also in line with their recognized priorities in various documents, including the Declaration of Human Rights, Paris Agreement, and Millennium Development Goals.

Since the Eastern Caribbean cannot produce goods that are competitive in global markets, it should not invest in large-scale export agriculture. Moreover, the sugar industry has been highly detrimental to ecosystem services and human wellbeing. However, as noted in Chapter 3, the banana industry has thrived in Martinique because of its membership in the European Union. Thus, the EU should reintroduce the preferential trade agreements it held with former British colonies. Although arable land is better suited to feed the islands’ populations and to stock resorts and restaurants, the existing banana industry can provide a boon to the region’s economy if it is competitive in global markets.

CARICOM can influence the developed world to enact these changes and provide greater aid by leveraging two recent trends in the region discussed in Chapter 3. The first is China’s increasing influence. The Caribbean is a highly strategic region for the United States. China’s
involvement is a threat to American hegemony. The other trend is economic citizenship, which the U.S. fears will create a terrorism threat in the region. Thus, CARICOM can craft deals with the U.S. and the UN to avoid further collaboration with China and limit or end economic citizenship programs in exchange for the above trade concessions, investment, and aid.

*Short-Term International Aid.* Since the track of hurricanes can be forecast several days before the storms strike, steps can be taken before a storm hits to lessen damages. Developed countries, especially the United States due to its proximity to the region, have a responsibility to help prepare the islands for storms. This is particularly true of its territories, Puerto Rico and the U.S. Virgin Islands. The U.S. federal government should provide the same relief to its territories as it would to states. The U.S. also has obligations to other islands in the path of storms, given its complicity in unjust economic structures and climate change. As noted in Chapter 2, it has established military bases in various locations across the Caribbean, allowing it to respond to disaster quickly. Thus, it should assist CDEMA when possible, facilitate the inter-island evacuation system and, if necessary, provide temporary asylum in the U.S. It should also supply provisions like food, water, and medicine. The U.K., France, and the Netherlands, which all govern territories in the region, should also provide as much aid as they would to their regions in Europe. The U.S. and other developed nations, former colonial powers, and current territorial ones should have ships ready to deliver relief to islands impacted by severe hurricanes. All of this assistance is in line with their obligations, as explained in Chapter 4. It is crucial that this immediate aid is delivered swiftly and comprehensively. As noted in Chapter 1 and in the Appendix, delays in aid can add to the psychological trauma of disasters.

*Long-Term Foreign Investment and Aid.* The debt countries in the Eastern Caribbean have from World Bank and IMF loans is a major obstacle to development and a violation to the
principles outlined in the Paris Agreement discussed in Chapters 3 and 4. These institutions should forgive the debt and offer new loans without strict regulations and restrictions. With this money, the region should invest in infrastructure, including the adaptative technologies outlined above, education, healthcare, and tourism.

As discussed in Chapter 4, developed nations that produce large quantities of greenhouse gases also have a responsibility to help the Eastern Caribbean adapt to climate change and stronger hurricanes. This is especially true given the underlying colonial forces at play. Therefore, countries like the United States and those of the EU should research new adaptative technologies that can protect the islands from rising seas and stronger storms. They should also provide funds for the implementation of these technologies as forms of aid and reparations.

Chapter 3 and 4 outline the pledges the developed world has made to address climate change, help developing countries adapt, and promote development worldwide. However, Chapter 3 also shows how wealthy countries have largely failed to fulfill these obligations. The Paris Agreement is a step in the right direction, especially in the vague mechanism described in Article 6. Drawing on its predecessor, the Kyoto Protocol, this mechanism could create a carbon market that benefits developing nations. For example, the Clean Development Mechanism and Adaptation Fund could be revitalized. Instead of mitigating their own emissions, developed nations could fund mitigative or adaptative projects in regions highly vulnerable to climate change like the Eastern Caribbean. Important precautions must be taken to ensure local participation and consent in this process. Therefore, projects should be led by the islands in collaboration with developed nations. These mechanisms should incentivize nations to carry out their promises and pay their colonial and climate debt to the Eastern Caribbean.
The Paris Agreement is ambitious in its goals and promises, but because the United States has pulled out, its efficacy is diminished. When the U.S. elects a presidential administration more cognizant of the urgency of climate change, the United Nations Framework Convention on Climate Change should update the Paris Agreement or craft a new agreement with enforcement mechanisms. Specifically, failure to reach the goals of this updated agreement should result in economic sanctions to coerce action. This is a highly controversial measure, as it threatens the sovereignty of nations. However, it may become necessary in what is becoming an increasingly dire situation. The agreement should be flexible enough to encourage passage, but stringent enough to achieve results. This legally binding treaty would be far more effective than the Paris Agreement.

*Grassroots Action.* The above policies present very heavy burdens to developed nations, former colonizers, and, to some extent, the governments of the Eastern Caribbean. As sovereign nations, they have no legal obligations to redress the wrongs they have committed against the Eastern Caribbean. Therefore, they will be very reluctant to enact any of these policies. For that reason, as discussed in Chapter 4, grassroots action is essential to pressure governments into fulfilling their ethical obligations. CARICOM can be useful in this realm. It should create a climate justice branch that coordinates activists across the region. Inter-island collaboration has been hampered by regional diversity, so CARICOM should work to overcome these differences and bring together the people of the region. The ethical responsibility of Eastern Caribbean elites to reduce the vulnerability of their poorer compatriots outlined in Chapter 4 also comes into play here. They should facilitate inter-island collaboration with CARICOM.

The CARICOM climate justice branch should hold summits across the region to gain support and lobby the UN for international recognition and aid. It should also mobilize activists
and engage in public education campaigns on individual islands. It should expand the understanding of environmental justice from conservation of natural resources and ecosystem services to sustainable economic development. This policy recommendation draws on the responsibility of the people of the Eastern Caribbean to advocate for themselves to the best of their individual abilities, not only through CARICOM, but to their national governments. Regardless of their independent or territorial statuses, the islands are autonomous. They may be more willing to enact the above policies than developed nations, but pressure from their constituents would encourage them in the right direction.

**Conclusion.** The Eastern Caribbean needs help in overcoming its vulnerability and preparing for a future of severe climate change and hurricanes. In its current state, the region will not be able to withstand the onslaught of extreme weather. Improvements such as new design strategies, political programs, and economic initiatives are crucial. However, the causes of the region’s vulnerability are mainly external. The developed world, through colonialism, globalization, and climate change, as noted in Chapters 2 and 3, have placed the Eastern Caribbean in its current position. As a result, Chapter 4 demonstrates that developed nations have an ethical obligation to encourage economic development and provide aid in adaptation. The obligation falls to the governments of these nations, which must act promptly. In addition, citizens of the Eastern Caribbean must put pressure on their governments and the international community to fulfill their obligations. If the developed world acts accordingly, the future of the Eastern Caribbean will withstand the threat of climate change and more destructive hurricanes.
Appendix. Research Study

In conjunction with my work on this thesis and with the guidance of my mentor, Dr. John van Buren, I conducted a research study to identify the social and psychological impacts of displacement from Hurricane Maria on the Puerto Rican population of New York City. The study was funded by the Fordham College Rose Hill Undergraduate Research Program. I was particularly interested in the impact of the change in environment from the tropical island to the temperate continent. I hypothesized that this loss in cultural ecosystem services would have detrimental social and psychological impacts. I hoped that the study would provide quantitative data on the consequences of strengthening hurricanes in the region.

The study originally consisted of a compensated questionnaire and interviews of refugees and staff at Puerto Rican community organizations in New York City. Unfortunately, after seven months of extreme difficulty in recruitment and extensive revision to the research methods that compromised the integrity of the study, I ended the project. Despite my inability to acquire quantitative data, I did learn valuable information in the recruitment process. It consisted of contacting Puerto Rican community organizations and asking for assistance in questionnaire distribution and interview coordination. My correspondence with these organizations ended up taking the place of interviews.

Of the organizations I contacted, New York Disaster Interfaith Services and the Center for Puerto Rican Studies at Hunter College provided the most information. I learned that in the immediate aftermath of Hurricane Maria, victims were promised aid by a variety of groups. More often than not, this aid never came. The trauma of being underserved in the wake of the disaster added to the trauma of the devastation and loss itself. The result, as I experienced in the course of recruitment, has been a firm unwillingness to participate in research studies among
refugees. More concerning, though, has been distrust of organizations offering aid and refusal to accept aid. Thus, the recruitment process helped to answer one of my overarching research questions. Hurricane Maria did inflict psychological trauma on its victims. The empty promises of assistance added to the trauma, which has followed refugees to their new locations and persists two years later.
Bibliography


