GEORGIA

ASSESSING THE COSTS OF CLIMATE CHANGE

CLIMATE TRENDS IN GEORGIA

The Georgia climate varies from the humid, marshy, low-lying coastal plains to the cooler inland foothills and the Appalachian Mountains. The entire state experiences four seasons, with summer temperatures rising above 90 ° F for at least 15 days each year (70 days for the southern parts of the state). The northern parts of the state experience winter temperatures below freezing and receive two to six days of snow annually. The southern marshlands have milder winter temperatures of 40 ° F to 50 ° F and rarely receive snow. Thunderstorms are common across the entire state in the spring and summer; severe weather, such as hail and tornadoes, also are common.[1, 2] Hurricanes regularly occur in Georgia during the summer and fall.[3]

OVERVIEW

In the coming decades, a changing climate could impact Georgia's economy. The most recent climate modeling predicts higher sea levels for the Georgia coast. These changes could be more pronounced if global emissions of greenhouse gases are not reduced. Coastal infrastructure and human health may to be affected in various ways that could result in many millions of dollars in losses. Since state economies are directly linked to those of neighboring states and regions, policymakers may wish to consider both state and regional policies to address climate change.

Climate change models produced by the Intergovernmental Panel on Climate Change (IPCC) in 2007 predict that Georgia could see average temperature increases of 4.5 ° F in winter and 5.4 ° F in summer, accompanied by a 5 percent annual increase in precipitation during the century.[4]

Sea levels along the Georgia coast are rising due to increasing global temperatures—records show that sea levels at Fort Pulaski, on the Georgia coastal border with South Carolina, are rising at a rate of 13 inches per century. Levels could rise 25 inches by 2100 if the current rate of climate change continues.[5]

ECONOMIC IMPACTS

Infrastructure

Georgia contains large and complex transportation, shipping and energy infrastructures, many of which are located on the state's 100-mile coastline. Changes to the climate—such as higher temperatures, heavier precipitation and a rise in sea level—could cause significant economic costs to this infrastructure.

Four major interstates traverse Georgia, and nearly 7,000 registered interstate trucking carriers operate in the state. The manufacturing industry, which comprises 12 percent of the Georgia state gross domestic product—$46 billion—relies heavily on the highway infrastructure to transport goods.[6,7]

Georgia spent $1.7 billion in 2007 on construction and maintenance of its highways and local roads. State expenditures on transportation and maintenance accounted for 9.5 percent of the state budget in 2007.[8] If intense storm activity due to climate change caused a 1 percent increase in the price of maintenance, it could result in an additional costs of $17 million for the transportation sector and trigger $12 million in economic losses for other sectors.[9] Most of the stretch of I-95 in Georgia lies within five miles of the coastline. This is an advantage for delivering goods to the shipping industry but increases the risk of storm damage.

Ports Brunswick and Savannah facilitated the trade of more than 24 million short tons of goods in 2007, a 58 percent growth in trade volume during the past five years.[10] Port Savannah is the fastest growing container port in the eastern United States, and Port Brunswick is the fourth largest auto port there.[11] Near Port Savannah is the Elba Island liquefied natural gas terminal, one of five in the nation.[12] Both ports are valuable to move goods to the southeastern United States because of their proximity to I-95, the easternmost U.S. north-south highway corridor. Rising sea levels threaten the reliability of these ports and their economic contribution to Georgia.

With 4,700 miles of tracks, Georgia has one of the most extensive rail systems in the southeastern United States. More than 80 freight trains pass through Atlanta daily.[13] Damage to the railways from precipitation, more frequent hurricanes, or more extreme temperatures could affect the annual cost to maintain and operate the system.

Atlanta Hartsfield-Jackson International Airport is the busiest passenger airport in the nation; it served more than 38 million passengers 2007.[14] Air travel and freight are important components of Georgia's transportation infrastructure. Georgia contributes 8 percent of the U.S. gross domestic product from air transportation.[15] Inclement weather is the top cause of airline delays,[16] and if severe weather becomes a more frequent due to climate change, delays could further damage the ailing air transportation industry.

Most of the electricity generated in Georgia comes from coal and nuclear power, both of which require water for operating and cooling.[17] In 2000, fossil fuel and nuclear power plants accounted for more than half the total surface water use in Georgia.[18] As sea level rises and contaminates fresh water, these thermoelectric power plants could compete for limited fresh water resources. Higher demand on limited water supplies could add to the cost of electricity generation.

Industry

Paper and wood product manufacturing contributed $3.3 billion and $1.9 billion, respectively, to the 2005 state gross domestic product[19] These industries could experience positive and negative effects from climate change.

Climate change could promote growth of trees used for wood product and paper manufacturing. Productivity of pine forests is predicted to increase by 11 percent by 2040 and of hardwood forests by 25 percent by 2090, as compared to regional productivity across the southeastern United States.[20] An 11 percent increase in productivity in the wood manufacturing industry by 2040 would create 6,531 direct and indirect new jobs and contribute nearly $350 million to the economy.[21] Secondary effects are likely to be seen by the transportation and shipping sectors—30 percent of the goods that pass through Port Savannah are wood pulp and paper products.[22]

The effects of climate change on the paper and wood products industries may not be all positive, however. The state is vulnerable to many types of storms. Tornadoes in the state inflict damages of nearly $300,000 per occurrence, and ice storms cost the economy an estimated $6.5 million.[23] If hurricanes and storms increase in intensity and frequency due to climate change, as some scientists predict, the effects on these industries could be costly. The USDA estimated that Hurricane Katrina destroyed or damaged more than 19 billion board feet of timber in Mississippi, Alabama and Louisiana, which translated to more $5 billion in damage.[24] The Georgia Forestry Commission recorded losses of 51 million board feet of pine and 1.6 million cords of hardwood during 30 major reported storms in the state. [25]

Agriculture

The agriculture sector contributed $2.6 billion to the Georgia economy in 2005.[26] Because agriculture depends heavily and directly upon the climate and day to day weather, crop yields are vulnerable to climate change. One study predicts yield decreases by 2020 of up to 15 percent for maize, 20 percent for winter wheat, and 25 percent for soybeans.[27]

It is important to note the competing and conflicting estimates of future changes to crop productivity due to climate change. A study by William Cline, for example, predicts an 18 percent decrease in crop yields overall in the southeastern United States by 2100.[28] The study provides only an overall estimate and does not account for individual crop yield changes, however.

Tourism

Georgia's state parks provide residents and tourists with recreation opportunities, and its historic sites preserve state history. Eight of Georgia's 77 state parks and historic sites are located along the Atlantic coast. Collectively, these coastal parks brought in revenue of nearly $2 million in 2007.[29] With sea levels predicted to rise 25 inches by the end of the century, revenues from coastal state parks could shrink due to diminished tourism, and maintenance costs could increase due to the need to protect the area from encroaching salt water.[30]

Beyond its state parks, Georgia attracts many people for hunting, fishing and wildlife watching. A survey by the National Fish and Wildlife Service found that fishing and hunting activities in Georgia resulted in $2 billion in spending, while wildlife-watching activities accounted for $3.6 billion.[31] Climate change may endanger some of the animals and fish that attract this revenue. Rising sea levels could alter the wetlands that are home to many fish species in Georgia.[32]

Coastal Areas

Rising sea levels and more frequent and intense hurricanes pose a serious threat to properties along Georgia's 100-mile coastline. The value of insured coastal property in the United States rose

179 percent from 1980 to 1993.[33] The real estate sector represents 10 percent of Georgia's state gross domestic product, about $37 billion.[34]

Property damages have increased 300 percent from an estimated $125 million in annual losses between 1900-1940 to half a billion dollars each year from 1960 to 1980.[35] Most of the increased cost of damage from hurricanes can be attributed to the development of high-value properties on the coastline. Many scientists see mounting evidence that hurricanes are increasing in number and intensity and attribute the cause to climate change, although some scientists debate this contention.[36] Hurricanes also pose a real threat to shipping ports—Hurricane Katrina caused $435 million in damage to the Port of New Orleans, and damage to the Port of Gulfport was between $300 million and $400 million.[37] Hurricanes could cause similar damage to Georgia ports. For example, Hurricane Ivan caused $68.8 million in property damages to Georgia in 2004.[38]

Rising sea levels are another potential impact of climate change. The cumulative cost of sand replenishment for protecting Georgia's coastline from a 20-inch rise in sea level may reach $154 million to $1.3 billion by 2100.[39] The total cost of protecting coastal assets and communities from sea level rise also could affect other sectors of the economy. Coastal erosion is projected to cost an additional $135 million annually in other sectors for a total of nearly $300 million. Nearly 5,000 jobs also could be lost due to coastal erosion.[40]

Drought

A higher risk of drought is a possible consequence of climate change.[41] Higher temperatures cause more surface water evaporation, in effect offsetting increases in precipitation. Georgia witnessed an extreme and costly drought in late 2007. At one point, more than 50 percent of the state experienced "exceptional and widespread crop/pasture losses" and "shortages of water in reservoirs, streams, and wells creating water emergencies."[42] Georgia still is recovering from this drought, which gripped most of the Southeast in 2007. Overall, the drought caused $1.3 billion in economic damage to Georgia, including crop losses of $83.8 million in hay, $160.1 million in cotton, $92.5 million in peanuts, and $63.1 million in corn.[43] If an additional 5 percent of crop losses are experienced due to climate change impacts, the direct and indirect economic losses could total nearly $110 million annually.[44]

The drought made homes in the drought-stricken areas more difficult to sell, causing losses in the real estate sector.[45] The water shortage caused by the drought has made Georgia officials consider water conservation measures, although a proposal to close public pools during summer 2008 provoked public outcry. Officials eventually decided to open the pools, but the specter of future closures remains, threatening losses for Georgia's $150 million pool industry.[46]

Health

Rising temperatures and flooding due to climate change could affect public health. A Johns Hopkins School of Public Health study correlated daily mortality rates and temperatures for 11 U.S. East Coast cities from 1973 to 1974. The study found a "minimum mortality temperature," above which heat-related deaths increase steadily. In Atlanta, for every degree above the minimum mortality temperature, heat-related mortality increases by 5.4 percent.[47] In 1983, 35 people died in Georgia due to heat-related causes; in 1982, when the average summer temperature was 4° F to 5° F cooler than in 1983, only three such deaths occurred.[48] The mortality rate in Atlanta increases faster than in cities at close latitudes, possibly due to the compounding effect of surface air pollution on heat-related mortality. Atlanta's air quality rating is one of the worst in the nation.[49]

Another Johns Hopkins study shows a link between higher-than-average precipitation and instances of waterborne disease.[50] More annual precipitation and intense storms can damage septic tanks and water treatment plants, increasing the risk of harmful particulates and chemicals in groundwater.[51]

Conclusion

Climate change in Georgia may place coastal infrastructure, some state industries, and growing coastal developments at risk. To hedge against these risks, a number of actions can be explored.

Protecting coastal developments and natural habitats—which will face increased risk for erosion from higher water levels and more intense storms—will be a leading concern. Since some sea level rise and climate change is likely regardless of greenhouse gas reduction efforts (the excess greenhouse gases already in the atmosphere "lock in" a certain degree of warming), integrating adaptation strategies into coastline development and habitat protection plans may be prudent. State conservation agencies can take steps to ensure the health of marshlands and coastal ecosystems: the first line of defense against coastal erosion. The state can also adapt sea and land transportation infrastructure to prepare for weather-related impacts and higher sea levels.[52]

Policies that provide research and funding on how to best mitigate the effects of rising sea levels, stronger storms and increased storm intensity on sea and land transportation infrastructure may also provide benefit. Efforts that maintain a dependable and robust transportation system and help coastal areas adapt to these changes may work to preserve Georgia's valuable tourism trade.

Missing Information and Data Gaps

More analysis of crop yield variability from climate change is needed to accurately predict economic effects of climate change. Studies also could be conducted to better determine the full economic effects of change to coastal ecosystems. How climate change affects human health in Georgia also is not fully understood at this time. How climate change affects urban centers is another area for future research. Georgia's three largest cities—Atlanta, Columbus and Savannah—could have unique vulnerabilities to climate change.

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