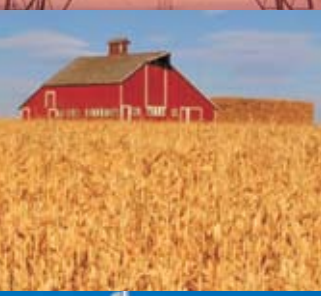





MICHIGAN

Assessing the Costs of Climate Change

Overview

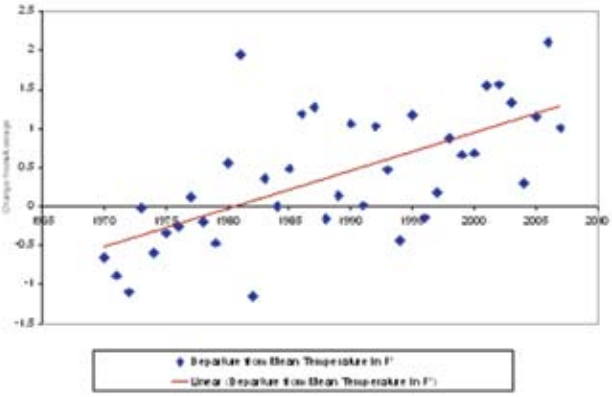
In the coming decades, a changing climate could increase economic impacts on Michigan and the nation. The most recent climate modeling predicts warmer temperatures and lower water levels for much of Michigan; these changes will be more pronounced if global emissions of greenhouse gases are not reduced. The state's shipping and water resources may be impaired as a result, which could result in billions of dollars in economic losses. This report explores how the climate may affect Michigan's economy and provides policymakers and others with insight into adaptation and mitigation options. Since state economies are directly linked to the economies of neighboring states and regions, policymakers may wish to consider both state and regional policies.

Climate Trends in Michigan

During the past century, Michigan's average temperature has risen, as shown in Figure 1. This trend is predicted to continue if climate change progresses unchecked. The models used to predict climate change in Michigan are based on 100 years of historical weather data, combined with the latest climate modeling. These models indicate that Michigan could become hotter and drier throughout this century; by 2030, Michigan summers will resemble those of present-day Ohio.

Models predict a 5° F to10° F increase in average temperatures in Michigan, and precipitation is projected to increase by 20 percent to 40 percent in the Midwest.[1] The increase in summer and winter temperatures, however, will outweigh the predicted increase in precipitation and cause an overall drier climate. Drier conditions could threaten the integrity of the Great Lakes-St. Lawrence shipping route. Changes in temperature and precipitation patterns also will cause northward migration of plant and animal species, with likely effects on state hunting, fishing, wildlife, and nature tourism industries. These trends, coupled with more frequent flooding and extreme weather events, also are likely to affect agriculture and forestry.

Figure 1. Change from Average Temperatures in Michigan in January

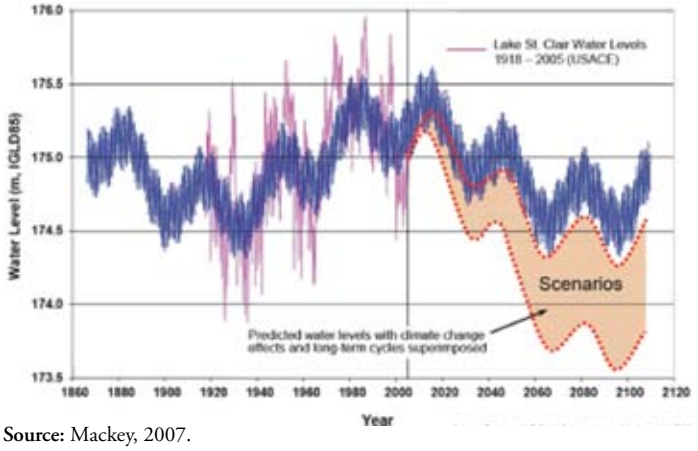


Source: NOAA, 2007.

One indicator of rising Michigan temperatures is the change in ice cover during winter months. Grand Traverse Bay in northern Michigan, for example, has experienced a decline in ice cover throughout the century. The number of years the bay froze each decade since 1851 decreased from an average of eight to 10 seasons per decade to only three between 1990 and 2000.[2]

The Great Lakes likely will experience changes in surface temperature, evaporation rates, surface currents and ice cover.[3] How these forces will interact and what effects they will have on the lakes remains to be seen. Some models predict that water levels in the Great Lakes will decline by 1.5 feet to 8 feet by 2100, disrupting commercial shipping infrastructure, recreational boating and hydroelectric power production. Figure 2 shows the predicted water level declines.

Figure 2. Water Levels in the Great Lakes



Source: Mackey, 2007.

Economic Effects

Shipping Infrastructure and Manufacturing Sector

Surrounded by four of the five Great Lakes and situated squarely on the Great Lakes-St. Lawrence Seaway, Michigan is home to more than 40 commercial ports.[4] Manufacturing, the largest economic sector in the state, contributes approximately 18 percent of the gross state product and depends on the seaway for cost-effective transport of goods.[5] The Port of Detroit, Michigan's largest, handled more than 17 million tons of goods, generated $680 million for Michigan's economy in 2000 and supported more than 10,000 jobs.[6] The three largest Michigan ports oversee more than $1 billion in foreign imports and nearly $4.7 billion in exports.[7]

If water levels continue to drop along the route, expensive channel dredging may be necessary. By 2030, dredging along the entire Great Lakes-St. Lawrence shipping route would cost between $92 million and $154 million annually[8] under a climate change scenario with falling Great Lakes water levels.[9] In a recent survey of the Great Lakes conducted by the U.S. Department of Transportation, respondents unanimously agreed that insufficient dredging of ports was the most important infrastructure issue in determining future investment decisions.[10]

If Great Lakes water levels decrease as expected, system connectivity along the Great Lakes-St. Lawrence route could decline by 25 percent.[11] This could cause an annual economic loss of almost $1.5 billion in foreign trade for ports in Detroit, Muskegon and Huron. The increased dredging needs in just the Port of Detroit may result in annual losses of $142 million and more than 1,500 jobs.[12] The entire state could lose an additional $2.6 billion and 13,000 jobs from lost imports and exports.[13]

Other Infrastructure

Flooding events—predicted to occur more often as climatic changes produce more heavy rainstorms—threaten the entire population. Michigan contains 36,000 miles of rivers and streams that may overflow, causing significant damage. A report sponsored by the National Oceanic and Atmospheric Administration (NOAA) showed that between 1991 and 2003 Michigan incurred average annual flood damages of $10 million.[14] Increased flooding produced by climate changes could indirectly affect other parts of the economy, resulting in economic losses as high as $506 million and job losses for nearly 9,700 workers.[15]

Water Resources

The Great Lakes Basin, the nation's fourth largest watershed, provides water for roughly 75 percent of Michigan residents. Public water supplies from the Great Lakes may be compromised as water levels decline. Additional stress on water supply may be caused by increased rainfall—predicted by climate change models—that may cause flooding and polluted runoff, which may require more expensive water treatment. (A study in Texas found that increased contamination of surface water raised the treatment costs by 27 percent.[16]) In Michigan, the cost of cleaning up ground water contamination from 1989 to 1999 totaled more than $367 million; nearly $30 million was spent in 1999 alone.[17] These costs may increase as lower water levels in state reservoirs lead to higher concentrations of pollutants. Although it is unclear how much additional water treatment will be necessary, the costs are real and likely to increase.

Other Effects

Agriculture

A recent Michigan State University report calculated that agriculture and related industries added $63.3 billion to Michigan's economy. The report further estimated that 725,000 people are directly employed in the industry and that it presents high future growth potential.[18] Disruptions to this important industry from climate change could have a detrimental economic effect statewide.

Rising temperatures have been shown to increase soil erosion by affecting microbial activity and changing the productive cycle of crops. Higher precipitation levels also have been found to increase erosion and runoff. Runoff could increase by nearly 50 percent in the Michigan Thumb area and by 310 percent in southeastern Michigan. The loss of topsoil also may increase. The Michigan Thumb area may experience soil loss of 105 percent, while southeastern Michigan may see a more than 270 percent increase in soil erosion by 2059.[19] Researchers estimate that soil erosion causes losses of nearly twice the value of crops produced, since

topsoil is so important for productive cropland.[20] If precipitation levels rise and cause more soil erosion and runoff as projected, Michigan could see annual economic losses from soil erosion in the range of $11.5 billion to $20.7 billion.

The dairy industry also is vulnerable to higher temperatures. Dairy production decreases at temperatures around 90° F, and losses begin when temperature reaches 77° F. This decreased productivity can translate into high economic loss. Climate models predict that, by the end of the century, Detroit will experience 30 to 50 days above 90° F. If the statewide effect is similar, the $1 billion milk industry would be affected.

Recreation and Tourism

Rich in natural beauty and abundant diverse species, Michigan offers a wide array of wildlife-related and outdoor activities. An estimated 3.5 million people—35 percent of the Michigan population—participate in fishing, hunting or wildlife observation. A total of $3.3 billion was spent on these three activities in 2001. Tourism generated profits of more than $14.4 billion, and 157,200 jobs are directly related to tourism.

One report on species' responses to rising temperatures found that 80 percent of those studied are changing their behavior, migratory patterns and habitats.[21] This indicates that higher temperatures will affect the state's native flora, which may undermine several established tourism activities. An estimated 2.7 million people—17 percent were nonresidents—participated in wildlife observation in 2001. Collectively, they spent more than $825 million.[22] If state wildlife habitat is reduced by 20 percent, the tourism industry could lose $165 million. In 2006, around $584 million was spent by 1.4 million anglers, 13 percent of whom were primarily interested in trout.[23] This species is sensitive to water temperature and stream flow. If trout fishing no longer is viable due to climate change, Michigan could lose more than $75 million in trip-related tourism.

Snow sports also contribute substantially to Michigan's economy. According to the Michigan Snowmobile Association, an average snowmobiler spends $150 per day on a trip; many trips last five days or more. The sport contributes more than $1 billion to the state economy.[24] The 16 ski facilities in the state generated nearly $50 million in 2002.[25] A Canadian study predicts that the length of the ski season could decrease by as much as 65 percent for the Brighton ski area by 2050. The study also predicts a cost increase for snowmaking of 10 percent to16 percent.[26]

Conclusion

Lower Great Lakes water levels may reduce connectivity along the Great Lakes-St. Lawrence shipping route and undermine a major mode of transportation for the manufacturing sector. More detailed research related to the effect of climate change on water levels in the Great Lakes and how lower levels would affect the shipping industry could help to plan for and allocate resources to mitigate negative impacts.

An improved assessment of the local climate change effect on fresh water supplies for drinking and agricultural use will help to plan for potential changes to water resources. Since flooding could be more intense when it occurs, planners and policymakers may wish to assess those areas most likely to be affected so that flood response plans can be modified and mitigation measures can be taken.

Since climate change may place more stress on wildlife, policies that create large, inter-connected wildlife preserves where flora and fauna can find varied ecosystems could improve their ability to adapt. Small preserves surrounded by development make it more difficult for plants and animals to adapt to climate change.

Missing Information and Data Gaps

The major missing links in calculating the unavoidable effects of climate change relate to the water supply networks in Michigan. Climate change effects are projected to cause both a rise in temperatures and more frequent severe rainfall. Better assessments of how these changes could affect water supply will help develop effective water resource plans.

Notes

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13. **TO BE DETERMINED**

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