Comprehensive Strategy for Reducing Maryland’s Vulnerability to Climate Change

Phase II: Building societal, economic, and ecological resilience

REPORT OF THE MARYLAND COMMISSION ON CLIMATE CHANGE
ADAPTATION AND RESPONSE AND SCIENTIFIC AND TECHNICAL WORKING GROUPS
COMPREHENSIVE STRATEGY FOR REDUCING MARYLAND’S VULNERABILITY TO CLIMATE CHANGE
PHASE II: BUILDING SOCIETAL, ECONOMIC, AND ECOLOGICAL RESILIENCE

The Scientific and Technical and Adaptation and Response Working Groups worked collaboratively to develop the Phase II Adaptation Strategy. This Strategy is the product of over 80 experts from the governmental, non-profit, and private sectors that held a series of meetings to synthesize the most recent climate change literature, to evaluate adaptation options and recommend adaptation strategies to reduce the Maryland’s overall vulnerability to climate change. The Strategy outlines adaptation strategies to reduce the impacts of climate change, including sea level rise, increased temperature and changes in precipitation within the following sectors: Human Health; Agriculture; Forest and Terrestrial Ecosystems; Bay and Aquatic Environments; Water Resources; and Population Growth and Infrastructure. The Phase II Strategy provides the basis for guiding and prioritizing state-level activities with respect to both climate science and adaptation policy within short to medium-term timeframes.

KEY RECOMMENDATIONS

Human Health

Conduct vulnerability assessments to gain a better understanding of risks and inform preventative responses.
Assess potential health threats and the sufficiency of Maryland's response capacity. Evaluate impacts to food safety and availability. Assess the vulnerability of Maryland’s populations and communities to changing health threats. Identify potential barriers to effective emergency response.

Integrate impact reduction strategies into State and local planning practices.
Improve response capacity through the development of new or expanded programs. Address climate-related health risks in hazard mitigation and emergency response plans. Support community engagement in planning and emergency response decisions. Pursue opportunities to enhance protection of Maryland’s “green infrastructure”.

Streamline and revise data collection and information dissemination channels.
Improve the resolution and availability of health and population data. Analyze health and population data along with other spatially explicit information (e.g., land use, air quality, water quality).

Agriculture

Increase crop diversity, protect against pests and disease, and intensify water management.
Promote diversification of crop species and varieties. Intensify water management and conservation through research, funding and incentives. Protect against incoming pests, weeds and disease. Support innovative solutions that foster adaptation and also reduce energy costs and carbon footprints.

Strengthen applied research, risk communication and technical support.
Enhance dissemination channels to improve the relay of climate information. Identify opportunities to support the transition of farm and agricultural practices. Enhance emergency response and risk management.

Enhance existing Best Management Practices (BMPs) and land conservation targets.
Evaluate the effectiveness of BMPs under future climate change scenarios. Assess and revise targets for agricultural land preservation.

Forests and Terrestrial Ecosystems

Expand land protection and restoration and revise targeting priorities.
Integrate climate data and models into existing resource assessments and spatial planning frameworks. Incorporate climate change adaptation strategies into state resource management plans. Collaborate with federal partners to support regional and national adaptation planning efforts. Update existing land protection targeting programs and project evaluation protocols. Develop climate change adaptation guidance and technical tools suitable for local government planning.

Adjust management practices and reduce existing stressors.
Strengthen State and local programs to slow the loss and fragmentation of forest and terrestrial ecosystems to new development. Revise Maryland’s best forestry management practices. Reinforce and incorporate strategies set forth by Maryland’s Sustainable Forestry Act of 2009. Evaluate sustainable forestry certification programs for opportunities to enhance climate resilience. Reduce existing stressors.

Foster stewardship on private lands.
Develop new tools to guide adaptation stewardship activities on private lands. Incorporate adaptation concerns into existing programs. Develop new conservation easement mechanisms to promote adaptation stewardship activities on private lands.
Bay and Aquatic Ecosystems
Advance protection of at-risk species and habitats.
Revise state-level protection targeting programs to reflect climate change adaptation priorities. Develop new protection and conservation mechanisms to promote adaptation stewardship activities on private lands. Amend legal mechanisms to designate and protect temperature-sensitive streams. Implement an adaptive management approach.

Restore critical bay and aquatic habitats to enhance resilience.
Proactively pursue, design, and construct habitat restoration projects to enhance the resilience of bay and aquatic ecosystems. Conduct an audit of state-owned lands to identify habitat restoration potential for enhancing ecosystem resilience and increasing on-site carbon sequestration. Increase on-the-ground implementation of existing stream restoration practices.

Reduce existing stressors.
Remove barriers to habitat connectivity. Reduce impervious surface cover. Prepare for new or expanding ranges of invasive species.

Foster a collective response to climate change.
Adjust bay and watershed restoration priorities in light of a changing climate. Integrate both adaptation and mitigation reduction strategies into natural resource management plans and programs. Revise fishery and wildlife management to build climate resilient safeguards. Increase collaboration between federal, state, local and regional climate change adaptation partners.

Water Resources
Ensure long-term safe and adequate water supply for humans and ecosystems.
Adopt and fund the recommendations of the 2008 "Wolman Committee" report. Manage water through the lens of future climate and population. Enhance planning and coordination within the water resource community. Encourage water suppliers to evaluate and improve their resilience. Promote demand management and water conservation practices. Assess, target and protect high-quality water recharge areas.

Reduce the impacts of flooding and stormwater.
Encourage the removal of vulnerable or high-hazard water supply and treatment infrastructure. Prevent inundation and overflow of on-site disposal systems. Revise Clean Water Revolving Fund criteria. Invest in an improved understanding and communication of flood probabilities and hazards.

Population Growth and Infrastructure
Ensure safety, clean water, clean air and sufficient infrastructure.
Address funding and revenue constraints to ensure adequate support for current and future infrastructure needs. Conduct a comprehensive analysis of the vulnerability of Maryland's infrastructure. Develop a "lead by example" investment policy to guide state investments. Reduce regional air quality impacts in Maryland.

Plan for precipitation-related weather extremes and increase resilience to rising temperatures.
Assess the economic costs resulting from severe weather events. Identify state investment needs to prepare for future weather emergencies. Accelerate use of improved stormwater management strategies and environmental site design (ESD). Enhance the preparedness of transportation system and utility providers. Develop operation contingency plans for critical infrastructure. Increase urban tree canopy. Strengthen building and infrastructure design standards.

Institutionalize consideration of climate change.
Promote integration of climate change adaptation strategies into state and local policies and programs. Integrate climate vulnerability data into state and local spatial planning frameworks. Consider climate change issues in combination with ongoing growth and development planning efforts. Explore incentives to promote sound planning practices. Investigate the impacts of climate change on future energy needs. Create a framework and standards for the placement and use of alternative energy.
KEY POINTS

- **Warmer temperatures and more variable precipitation will likely lead to changes in crop and animal production and pest management.** Maryland farmers will likely have to plant different crop species and more drought-tolerant varieties of the ones they currently plant. Farmers will likely face increased costs associated with the summer cooling of poultry and livestock and the need for a rapid response to variable precipitation and pest infestation.

- **More intense water management and increased technical and financial support for agricultural transitions will help boost resilience.** Changing climate is very likely to cause changes for farmers. They may need to shift the timing of planting or fertilization, or increase irrigation and the cooling of animal production facilities. As farmers adjust, state and local governments will need to provide new education and training and to help alleviate the costs and risks associated with these changes.

- **Farmers need new information tools to support decisions regarding environmental and economic conditions.** Increased investment in improved monitoring and forecasting tools would increase a farmer’s ability to prevent, rather than react to, adverse impacts.

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**Figure 2.1: Current Maryland protected and unprotected agricultural lands. Targets for protection should be amended to take into account climate change considerations, placing priority on those farms that are likely to be more resilient in a climate change scenario.**

Preserved land includes land that is permanently protected from development with a perpetual conservation or open space easement or fee ownership, held by a federal, state, or local government or non-profit organization for natural resource, forestry, agriculture, wildlife, recreation, historic, cultural, or open space use, or to sustain water quality and living resources.
### COMPREHENSIVE STRATEGY FOR REDUCING MARYLAND’S VULNERABILITY TO CLIMATE CHANGE

### INTRODUCTION

Agriculture is the largest commercial industry in Maryland, employing about 350,000 people, primarily in the north-central and Eastern Shore regions. Farms occupy about two million acres, or about one-third of the State’s land, though individually the farms are, on average, much smaller than those in other states. A lot of these smaller farms are only partially owned or leased by the farmer (Figure 2.1). Maryland’s agriculture is diverse, including nursery plants, dairy products, beef cattle, vegetables, wheat, horses, and fruit. Poultry, fed in large part by locally produced corn and soybeans, represents the largest market value (Figures 2.2-2.3).

Projected increases in temperature, precipitation variability, and frequency of extreme events associated with climate change are likely to affect the conditions upon which farming has been established. Many of the stressors farms already face are likely to intensify or become less predictable: drought frequency, winter flooding, pests and disease, and ozone levels. These changes occur in the current context of the high economic uncertainty and small profit margins, and are likely to result in increased costs to both farmers and consumers. Farmers will need technical and financial assistance from the State to help develop a strategy to adapt to a changing and more uncertain future.

![Image of flooded farm fields](https://via.placeholder.com/150)

_Flooded farm fields after heavy rains in July of 2006._

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<table>
<thead>
<tr>
<th>Product (ranked by 2007 market value, USDA Census)</th>
<th>Climate impact</th>
<th>Adaptation strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poultry</td>
<td>Increased cooling costs; decreased production; changing disease presence</td>
<td>Improve energy efficiency of housing; bioenergy use; improve ability to monitor disease and quarantine</td>
</tr>
<tr>
<td>Grains, oilseeds, dry beans, peas</td>
<td>Water stress: increased irrigation use; winter flooding; changes in crop yield quantity and quality</td>
<td>Diversify cultivar and crop types; improve water management systems; improve pest forecasting</td>
</tr>
<tr>
<td>Nursery, greenhouse, floriculture, sod</td>
<td>Increased cooling costs; water stress</td>
<td>Establish emergency response systems; improve energy efficiency of housing</td>
</tr>
<tr>
<td>Milk and dairy</td>
<td>Decreased milk productivity; changing disease presence; low-quality pasture during drought</td>
<td>Increase shade and cooling; improve ability to monitor disease and quarantine; manage pastures for drought; farm heat-tolerant breeds</td>
</tr>
<tr>
<td>Cattle and calves</td>
<td>Changing disease presence; heat stress; low-quality pasture during drought</td>
<td>Increase shade and cooling; improve ability to monitor disease and quarantine; manage pastures for drought</td>
</tr>
<tr>
<td>Vegetables, melons, potatoes, other crops, hay</td>
<td>Water stress: increased irrigation use; winter flooding; changes in crop yield quantity and quality</td>
<td>Diversify cultivar and crop types; improve water management systems; improve pest forecasting</td>
</tr>
<tr>
<td>Horses, ponies, mules, burros, donkeys</td>
<td>Heat stress; low-quality pasture during drought</td>
<td>Increase shade and cooling; manage pastures for drought education about heat stress</td>
</tr>
<tr>
<td>Fruit trees, nuts, berries</td>
<td>Water stress: increased irrigation use; increased pest damage</td>
<td>Diversify cultivar and crop types; improve water management systems; improve pest forecasting</td>
</tr>
</tbody>
</table>

Figure 2.2: Major Maryland agricultural products, climate impacts, and adaptation strategy options.
As the climate changes, farmers, the farm credit industry, and regulators of agricultural management practices will likely face a large and growing degree of uncertainty. Increases in temperature, and precipitation variability will shift the environmental conditions upon which Maryland farming has been fundamentally based. This will likely affect the farming community’s ability to plan ahead, increase the required intensity of farm management, escalate equipment costs, and impact associated industries. Further, consumers of agricultural products will also be affected as the availability of food may be impacted by an increased frequency of severe storms and short-term droughts. Although the stresses associated with climate change are conditions that farms have been subject to before, these stresses are likely to become more intense. Increased temperatures may be considered beneficial in terms of extending the growing season, but high summer temperatures also can severely affect crop yield and animal production. Potential increases in ozone, a chemical toxic to plants, are also likely. Adaptations by farmers to shifts in environmental conditions will require significant technical and financial support from federal, state, and local agencies in order to minimize impacts.

Precipitation extremes will likely affect drainage and water retention

Efficient water management may pose one of the largest operational challenges for farmers. Both drought and flooding conditions have negative effects on agriculture, resulting in production losses and requiring increased irrigation. Drought conditions reduce crop yields and dry pasture grasses on which grazing animals feed. In certain areas, winter precipitation increases may flood fields and delay spring planting, which hampers farmers’ ability to produce and competitively market early-season, high-value crops such as melons, sweet corn, and tomatoes. In areas such as the lower Eastern Shore, where water drainage ditches are used to manage standing water from current average storms, the insufficiency of this drainage infrastructure to manage future high water flows will make it more difficult for the individual farmer to manage soil moisture. Poultry houses in these areas also will require siting or design alterations to avoid future flood impacts. An example of the predicted increased frequency of severe precipitation events and their consequences for farmers is the occurrence of three “thousand-year” rainfalls in Minnesota over the past seven years.4

Crop and animal production will shift

Current crop and animal management may not be suitable for rising temperatures, new pests, and increased precipitation variability. Climate change may be advantageous to some crops, however, by way of an extended growing season and increased carbon dioxide levels. Soybeans, for example, thrive upon increased carbon dioxide. Although increased carbon dioxide levels may benefit such crops, temperature increases, increased frequency of drought, and increased ozone may negate this effect (Figure 2.4).5,6,7 For all plants, when their optimal temperatures are exceeded, their life cycles are shortened, which can significantly reduce their viability and yield.8,9 These effects will likely cause shifts in the types of animals and crops raised and produced in Maryland. Many seed varieties were developed during past periods of greater climate stability. These seed supplies have very narrow genetic diversity. As a result, there is much inherent risk if a widely grown strain turns out to be inappropriate for the year, due to unforeseen stressors caused by drought or flooding. Moreover, more frequent periods of drought in summer months may not only force farmers to plant drought-tolerant varieties, but to irrigate their crops, increasing production costs. In some coastal areas, this increased water withdrawal, combined with sea level rise, can lead to saltwater intrusion into aquifers. Increased water withdrawals may also compete with other uses, in particular public water systems and/or individual homes. In low-lying areas subject to periodic tidal inundation soil quality may decrease, inhibiting plant growth.

The poultry industry is Maryland’s largest agricultural component, and consumes the majority of the State’s corn and soybean production. In a climate change scenario, the overall heating requirements for chicken houses and other...
livestock barns may be reduced. However, cooling will also need to increase significantly in the summer, and although energy pricing is difficult to predict, this may outweigh heating reductions in winter, thereby increasing total costs. Increasing the operating costs of poultry production could significantly affect profits. Dairy and beef cattle farms, nursery operations, and greenhouses are also affected by increased energy costs. The dairy industry in Maryland has already declined due to market conditions and this trend is likely to continue. Increased temperatures will put a strain on feed production, which results in lower milk production. Beef cattle producers may shift to more heat-tolerant breeds. Further, horse feed may be affected, and may need to be imported from farther distances, increasing operating costs.

**Pests, disease, and weeds will likely shift with climate**

The types of pests, diseases, and weeds seen on farms and affecting animal production will likely change and become less predictable, leaving farms more vulnerable to invasions. In addition, the frequency of pesticide application in southern regions of the United States in contrast with cooler northern regions suggests that pesticide application may increase as temperatures warm. One disease expected to expand its range is soybean rust, a fungal pest that has caused 40 to 60 percent crop losses in the southern United States. Although soybean rust has not yet been an issue on Maryland farms, there is an increasing probability that an infection resulting in crop loss will occur in the State as temperatures rise. Weed species are also more likely to respond to increasing carbon dioxide than most crops. Research suggests that glyphosate, the most widely used herbicide in the United States, is likely to become less effective as carbon dioxide levels rise. Additionally, warmer, wetter winters create a climate more suitable for animal or plant disease, such as the fungus that causes wheat scab. Bees, primary pollinators for many crops, are currently affected in many areas by bee colony disease and colony collapse disorder. Although the relationship between this disease and climate is unclear, it may also compound the problems presented for some crops by climate change, affecting the viability of crops that are dependent on bees for pollination.

Vulnerability to pest and disease invasions is highly affected by how quickly and unpredictably invasions occur. The speed at which changes in pest pressures occur and a farmer’s ability to rapidly adjust farm operations will be essential. Large-operation farmers may not be able to respond to changes quickly enough, and smaller farmers may be less capable of paying the costs associated with field or animal treatment. Additionally, the current economic situation has caused a retrenchment in Maryland’s most reliable information conduits such as University of Maryland Extension. These systems are unlikely to be sufficiently able to track, monitor, and prepare farmers for rapidly occurring invasions.

**Figure 2.4**: Research by Morgan et al. (2006) demonstrates that elevated ozone levels can reduce soybean yield (measured by seed weight). Ozone levels are likely to increase as climate changes.
Chapter 2: Agriculture

Current applied research, education, and outreach are not sufficient

Maryland’s applied agricultural research, education, and outreach occur through a few key channels. Programs such as those offered by the University of Maryland Extension and the Soil Conservation Service provide unbiased services, information, and training on issues such as nutrient management, farm management, integrated pest management, marketing, and other production issues. Organizations such as 4-H, Future Farmers of America, and LEAD Maryland offer programs to prepare future leaders in the farm community. High school, undergraduate, and graduate education support development of future agricultural scientists, educators, and agribusiness professionals, and promote implementation of novel and advanced management technologies. Funding for these programs has recently been constrained. In some cases, these gaps in information channels have been filled by private industry, most notably seed and chemical companies that have a primary mission of selling their products and services. Further, current ability to monitor and forecast information about changing pests, climate, and economics is relatively limited. The reduction of these information channels reduces a farmer’s capacity to adapt to changes that may come.

Cost and intensity of farm management will likely increase

Although farmers are accustomed to adapting to both dry and wet years, the variability and extremes associated with climate change are more difficult to predict. The capital costs associated with adaptation may be too large for small-scale farmers, who already operate on very narrow margins. Additional risk may be added to the existing risks associated with local, national, and global markets. Farmers along Maryland’s many miles of shoreline also face the long-term possibility of losing arable land to sea level rise. As a result, farmers will likely need to change the way they manage and what they grow.

Increased temperature and precipitation variability may translate to increased production costs. For example, increased use of animal cooling and irrigation, new irrigation equipment, and more frequent pest treatment all add to the total cost of farm operation. Although measurements have not been made frequently enough to discern a definitive trend, irrigated agriculture has steadily increased from 1997 to 2002 (Figure 2.5).2 If water resources become more scarce in certain areas, restrictions or permit fees may also be placed on water use for irrigation. Climate change may lead farmers to try to apply fertilizer, pesticide, and other chemical treatments more quickly, leading to a scaling up of equipment or increased equipment costs. For example, the use of commercial fertilizer rather than spreading manure may increase, as it is more quickly applied in a narrow window of weather conditions. This shift would increase the urgency to enhance options for the management of unused manure, so that changes do not result in nutrient concerns for ecosystems. Similarly, the cost of bringing produce to local markets becomes more challenging, as it will likely become more difficult to predict pre-planned dates of harvests to meet seasonal market demands. All of these impacts contribute to the economic uncertainty surrounding the future of agriculture.

Figure 2.5: Percent of total Maryland farmland that is irrigated (USDA).10

Agricultural irrigation on a farm on the Eastern Shore. Irrigation usage and costs will likely change with precipitation variability.
Many of Maryland’s agricultural operations already produce on very thin economic margins. Climate change is likely to add to current levels of stress. The following strategies are therefore geared toward building resilience by reducing stress and uncertainty. Their benefits are not exclusive to a climate change scenario; many will improve the viability of Maryland agriculture regardless of change. Climate change adds a greater sense of urgency to their adoption, due to both the speed and severity at which impacts might occur.

It is the broad goal of these strategies to help reduce stress on agricultural operations and to build the resilience of Maryland farms, despite changes they may face in the future, and to improve the quality of the Chesapeake Bay and its watershed. As climate change may affect the intensity of how farmers manage, shift agricultural best management practices (BMPs), and affect the implementation of relevant regulations, farmers need to be prepared and supported for adjustments that may be required. This may be the case for pollution regulations associated with reducing nutrient discharges to achieve Maryland’s Watershed Implementation Plans (WIP) to achieve the Chesapeake Bay Total Maximum Daily Load (TMDL) by 2020, as in the State’s goal, or by 2025 as per federal mandate.

As precipitation variability increases, diversifying crop species and varieties is a strategy already being employed by some farmers (e.g., planting varieties that mature at different times or have different genetic resistance to pests). Rather than planting a single crop variety, a portfolio of different varieties may be a lower risk strategy in a highly variable climate. As precipitation patterns become less predictable, having a higher diversity of crops will increase the likelihood that a few varieties will do very well, whereas the planting of a single variety may result in increased vulnerability to adverse weather conditions. An investigation into the production and economics of various diversification schemes needs to be conducted. Funding for education and outreach programs is also needed to communicate these strategies to farmers and to help build more resilient business models. Improved water management is also needed to enhance a farmer’s capacity to better handle periods of drought and heavy rains.

**Priority Recommendations:**

- **Promote diversification of crop species and varieties.** MDA should continue and expand existing efforts to work with farmers at the local level to increase crop diversity. The agency should identify and offer support to farms that may benefit economically by increasing diversity through different crop rotations, different cropping schemes such as inter-cropping, novel pest management strategies, or production practices.

- **Intensify water management and conservation through research, funding and incentives.** MDA’s Drainage Management Task Force should review current resources and strategies geared towards water management and identify necessary resources, education, and financial support to support “climate-ready” water management. This group should also work with local jurisdictions to improve public drainage design in agricultural areas, so that both farms and roadways can balance proper drainage and retention.
• **Protect against incoming pests, weeds, and disease.** MDA should engage the US Department of Agriculture (USDA) and surrounding states to improve and expand regional programs that forecast, detect, prevent, and eradicate pest species. Furthermore, MDA should work with the climate and agriculture science communities to develop efficient early-warning systems for likely invasions of insects, weeds and diseases.

• **Support innovative solutions that foster adaptation and also reduce energy costs and carbon footprints.** New incentives for agricultural biofuel development, methane recapture, and carbon and nutrient trading markets offer opportunities for farmers to both reduce their dependency on external, fluctuating energy costs and to benefit the environment. Maryland Energy Administration (MEA) and MDA should work together with University of Maryland Extension to support these efforts and expand technological innovation in the field.

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**Strengthen applied research, risk communication, and technical support**

Preparation for climate change will require an interdisciplinary effort of the large agricultural community, including not only farmers, but MDA, University of Maryland Extension, DNR, MDE, farm credit and insurance industries, as well as agricultural land trusts. Communicating research, monitoring, and new technical information will be a vital component. While there should be an increased emphasis on existing programs, greater investments should be made in outreach, education, and research services (e.g., University of Maryland Extension, Soil Conservation Districts, Natural Resource Conservation Service, non-profit, and commodity organizations) that offer programs to help farmers assess the costs and benefits of various response options.

**Priority Recommendations:**

• **Enhance dissemination channels to improve the relay of climate information** among research institutions, Extension education, and outreach organizations. The outcome should be a strengthened ability to relay forecasted information about pests, climate impacts, and the agricultural economy to farmers.

• **Identify opportunities to support the transition of farm and agricultural practices.** Agricultural operations likely to undergo major transitions may be the most economically vulnerable. MDA should work with partners including farm credit and insurance operations to do a vulnerability assessment and establish priorities for increased education, funding, and risk management efforts to support the transitions for these vulnerable farmers.

• **Enhance emergency response and risk management.** For example, if summer energy surges lead to brownouts, and farmers are unable to cool poultry houses, severe animal losses can occur. Farmers need options to avoid these losses in acute crises. The State should design an emergency response strategy that addresses climate change impacts such as severe heat and other extreme events.

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**Monitoring and forecasting soybean rust**

The Integrated Pest Management (IPM) Pest Information Platform for Extension and Education (PIPE) is one example of a system that could be used to track and forecast pests so that farmers may be prepared for invasions. The platform includes a daily update of the geographical progress of soybean rust, excerpted below:

“On September 30th, soybean rust was reported for the first time in 2009 in North Carolina in a soybean sentinel plot in Johnston County, and in three more counties in Mississippi and Tennessee. On September 29th, soybean rust was reported for the first time in 2009 in Virginia (Suffolk County), and in eight counties in Arkansas, two counties in Georgia...In 2009, soybean rust has been found in 14 states and 293 counties in the United States, and in two states and five municipalities in Mexico.”

For more information: [http://sbr.ipmpipe.org](http://sbr.ipmpipe.org)
Comprehensive Strategy for Reducing Maryland’s Vulnerability to Climate Change

Enhance existing best management practices and prioritize land preservation targets

In addition to shifts in agricultural production, changes in seasonality and precipitation are likely to affect BMPs which are geared towards protecting water quality in the Chesapeake Bay and its watershed. Practices such as manure injection (injecting directly into the soil), split fertilization (spreading fertilizer at staggered times throughout the growing season), and precision agriculture (using global positioning system (GPS) to map in-field variability and treat accordingly) can be employed to improve the timing and application of fertilizers and pesticides.

Priority Recommendations:

- Evaluate the effectiveness of best management practices under future climate change scenarios. Current cropping systems may be less effective if not accompanied by improved water management or soil-enhancing practices. Alternately, it may become necessary to switch to winter cover crops that are more tolerant of heavy precipitation, as winter wheat is prone to flooding impacts. The State should evaluate options for improvement, and work with agencies such as the MDA and the Natural Resource Conservation Service that provide cost-sharing programs to enhance the use of these BMPs. Supporting research will be needed to assess potential changes in BMPs.

- Assess and revise targets for agricultural land preservation. Maryland’s many agricultural land conservation organizations such as the Maryland Agricultural Land Preservation Foundation, and the Maryland Environmental Trust should work together, along with county planners and private landowners, to assess and target agricultural areas for preservation. Assessments should include an analysis of future water resource and drainage issues and the need for agricultural diversity given future climatic conditions. Targeting should be aimed at preserving the most productive farms that are likely to adapt successfully to future climate change. Local markets for farm products should be included in this assessment.

CASE STUDY: Sustainable water management

The Maryland Agricultural Water Quality Cost-Share program provides grants to farmers to install conservation measures or best management practices (BMPs) to reduce impacts to manage water and erosion to safeguard water quality. Some of these strategies have additional benefits for reducing climate change impacts. Among the BMP options are structures for water control systems, which can be used to control water elevation and drainage. Sensors can also be placed within the field to relay to the farmer whether irrigation is needed. These strategies can be used to improve water retention on-site and to reduce impacts to surrounding waterways.
Tools and research

- Increase funding and development of long-term monitoring and forecasting decision-support tools. Web-based programs such as the Integrated Pest Management (IPM), Pest Information Platform for Education and Extension (PIPE) and the soybean rust monitoring initiative should be established for other pests and disease likely to increase in Maryland.

- Undertake a mapping effort to evaluate spatial and seasonal patterns of risk. MDA should work with DNR to identify agricultural areas that are most likely to be affected by climate change so that the more resilient areas are prioritized for protection in the short term, or for those less resilient farms, incentivized to transition in the long term.

- Study and develop economically viable diversification practices as well as crop varieties and animal breeds that are more tolerant of high temperatures, saline soils, drought, insect pests, and disease.

- Identify the effects of increases in winter precipitation, more frequent summer drought and greater summer demand for irrigation on water availability. MDA’s Drainage Management Task force should take on a similar effort in the Coastal Plain region to a current effort by Interstate Commission on the Potomac River Basin, The Nature Conservancy, and Army Corps of Engineers which are currently working together to study some of these relationships for the entire Potomac River Basin.

- Increase the investigation and investment in pilot projects that both reduce carbon and generate energy on the farm through waste or other means.

- Research new innovative and cost-effective strategies for improved water management systems and design. In-field sensors that measure water levels and water control structures are examples of current options.

- Support research on how Maryland farmers can take advantage of opportunities to employ carbon sequestration strategies or reduce dependency on external energy sources by using farming BMPs, methane recapture, anaerobic digestion, and other methods.

Education

- Explore innovative ways to improve the communication of adaptation planning principles, focusing on understanding current information conduits (public and private) and improved distribution of information.

- Engage agricultural-based leadership and fellowship programs, including 4-H, Future Farmers of America, and LEAD Maryland to support climate change research and education.

- Incorporate climate science and impact information into academic curricula.

- Participate in the Maryland-Delaware Climate Change Education, Assessment and Research (MADE-CLEAR) initiative to promote increased awareness of the causes and consequences of climate change in communities where agriculture is important.
REFERENCES


