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The Future of Sustainable Farming and Forestry in Maryland

A REPORT COMMISSIONED BY THE HARRY R. HUGHES CENTER FOR AGRO-ECOLOGY, INC

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Executive Summary

One priority for the study was to assess likely effects of public policies—specifically those related to the Chesapeake Bay Restoration and smart growth—on the sustainability of agriculture and forestry in Maryland. For instance, these policies include use of nutrient management requirements for pollution control from farms; and use of zoning and other land use management tools for community revitalization, fiscal efficiency and land preservation. We recognized that factors somewhat independent of these policies—specifically advances in technology, changes in markets and business models, and evolving US trade policy—have major effects on sustainability as defined (sidebar). In this report, we address the effects of both the policies of interest and these important external factors.

Key Findings and Conclusions

Evolution of food business industries and trade agreements has created winners and losers for market access. As discussed in Chapter 1, agricultural industries across the spectrum from farms to retail moved from small scale, local production and processing and mom and pop stores to corporate behemoths in the twentieth century. Larger companies sought out larger, lower cost suppliers. At the beginning of the century, much of our food, particularly perishable food, was locally sourced. By the end of the twentieth century, food industries had grown in scale, and improved transportation networks allowed food to be transported around the globe. Major chains controlled 95 percent of all food purchased by the end of the century. With the exception of poultry, Maryland farmers have very limited access to chain store shelves, and therefore to the ultimate national and global consumer markets for their products.

For purposes of this report, sustainable farming and forestry means profitable, income producing operations that can be continued for the foreseeable future while maintaining productive, healthy soils and working land, without excessively compromising water resources and natural resource integrity in the surrounding environment. It does not refer to any particular crop, farming or forestry system.

Specialized large-scale production to supply the food industry, primarily in the Midwest and Western states, has made Maryland farms less competitive for most product categories. Farm and forest production moved West in the twentieth century, reducing profitability in the East. Farms in the Midwest and West are larger than those in older farm communities in the East. With irrigation systems and growing seasons lasting year-round, California became the fruit and vegetable basket of the country. Dairy and livestock producers also flourished in California. The Midwest became the U.S. grain belt and the Northwest became the source for lumber. By the end of the twentieth century, the states along the East Coast struggled to maintain their agricultural and forestry economies.

In one sector, this specialization of agricultural operations has benefitted Maryland: the poultry industry has flourished in Delaware and on the Eastern Shore of Maryland and Virginia. It benefits from a fairly extensive rural landscape relatively free from intrusive impacts of development, and a symbiotic relationship with the grain industry on the Delmarva Peninsula. Grain farmers sell their grain to feed the poultry

and use the poultry litter to feed their crops. Details are found in Chapter 1.

Emerging markets and changing consumer preferences and demands present opportunities. As discussed further in Chapter 1, a local food movement has been emerging in the twenty-first century, one of a growing number of signs of new or expanding markets based on consumer tastes, demands and purchasing**.** Although local vegetable production for the fresh market is only a small percentage of gross farm production, there is broad consumer interest and producers are responding. Maryland could be in a position to reclaim some of its food supply chain. Closely linked to this trend are other signs that agriculture is adapting to new consumer preferences. As one Perdue representative said, "Perdue is finding product attributes that people want. The market for organics is one example. We are the largest purchaser of organic grain in the world. It is growing rapidly from a small base." In discussing lending trends, a representative from MidAtlantic Farm Credit described clients responding to niche market demands for products that are non-antibiotic and organic. Findings are discussed in Chapter 2.

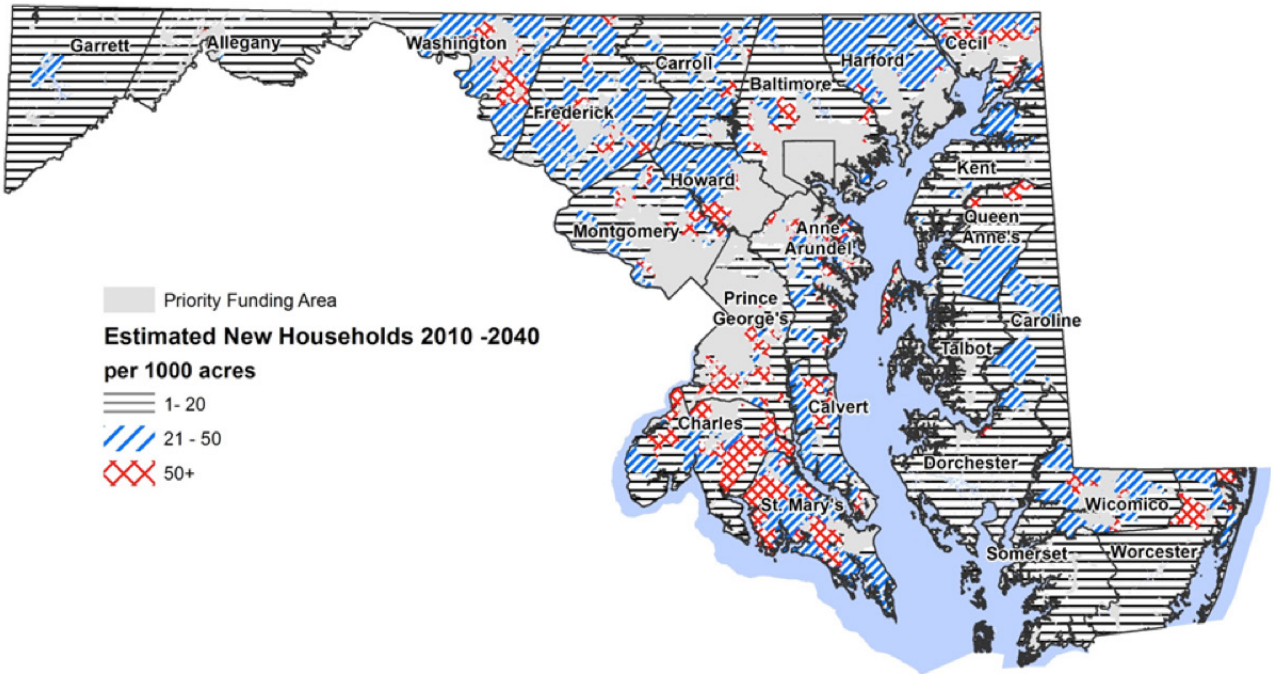
Landscape fragmentation by residential subdivision and development is among the greatest threats to farming and forestry in Maryland (Chapter 3). Maryland is part of the Northeast megalopolis that extends from Boston to Washington D.C. Since World War II, urban and suburban development has consumed farmland along the I-95 corridor and within commuting distance of cities along I-95. The suite of state and local land preservation programs and improved local land use planning and implementation programs have significantly slowed the conversion of farmland and forestland in recent years and succeeded in permanently protecting considerable acreages of contiguous productive farm and forestland in some places. However, continued fragmentation by residential development in rural areas—and the land use policies that make this possible—are likely to continue to impact sustainable farm and forestry options as the state population grows. The map below provides a general geographic overview of those impacts.

These impacts are not simple or uniform over time and place on industry sectors. Perhaps the greatest and most consistent impacts over time have been on large scale livestock operations and on timber harvesting (logging), in metropolitan (Baltimore and D.C.) regions and in parts of the state transitioning from rural to metropolitan status (Southern Maryland). Moving forward, the biggest threats will continue to be in these areas but may be increasingly significant in some parts of the Eastern Shore and Western Maryland. Details are in Chapter 3.

In making these observations, it is important to recognize that the impacts of fragmentation by development have occurred in tandem with equally or more significant impacts of several external factors (mentioned above) over the last century. Impacts of these factors are discussed further in Chapter 1.

The array of environmental measures enacted to clean up the Chesapeake Bay and health, food safety and land use regulations have presented both economic and social challenges and potential benefits to Maryland farmers (Chapter 2). Increases in production and management costs, record keeping and reporting have certainly affected the bottom line. Costs of regulation have likely added to market factors to encourage consolidation and integration of production and the decline in mid-sized farms. There is real concern that Maryland farmers may lose a competitive edge due to increased production costs caused by compliance with environmental regulations. However, it is also clear that so far these impacts have been less than feared, and that significant internal efficiencies and management improvement have resulted from the focus on regulatory objectives. From an environmental point of view, Maryland's farmers have been successful at implementing conservation practices and lowering pollution rates overall.

Estimated Residential Development Outside PFAs, 2010–2040, Maryland



Farmers that have and will continue to experience the biggest impacts are larger livestock confinement operations. Dairies using confinement will have the biggest burden since virtually all of the regulations addressing nutrient management apply to them. Those located on high phosphorus soils will have added challenges. Given that these pressures will increase at a time of decline for the industry, the regulations could well exacerbate the decline, particularly in the modest number of medium to large dairy operations remaining.

The poultry industry, especially on the Lower Eastern Shore, will be the second most impacted agricultural sector. Farms primarily in Lower Shore Counties where soils have been receiving litter for the longest time will face the most dramatic changes. However, if estimates from this report turn out to be accurate, the transition should be feasible and the results both economically and environmentally sustainable.

Health, food safety and land use regulations have also created barriers to agricultural value-added products, direct marketing opportunities, and new uses of commercial spaces and activities on farms. Many are designed for larger industrial applications. These rules slow permitting and exaggerate the costs for new, small enterprises and restrict their production and marketing opportunities, perhaps without commensurate positive effects on food safety. Size-inappropriate regulations represent lost production and marketing opportunities for Maryland farmers, for whom value-added processing and marketing might bring significant economic benefit. This is a complex regulatory field and requires further research as a basis for sound policy recommendations.

Different regulations concerned with the environment are impacting the Forestry industry (Chapter 2). For forestry, it appears that the biggest regulatory impacts come not from nutrient concerns but from sediment and erosion control and logging permits, and the rules governing certification of timber for green building. Sediment and erosion control and logging permits can be relatively costly, detailed and complex for owners and loggers of the many small (< 10 acres) woodlots comprising most of Maryland's remaining private forestland, and may require as much as 4-6 weeks to complete.

Procedures differ in every county, complicating the process for loggers operating in multiple jurisdictions. The plans are only valid for two years, a short time in the scheme of forest management plans. Cost and delays in plan and permit review make it difficult to take advantage of seasonal windows of opportunity for harvesting, particularly during the winter, when some areas may be dry enough to access and harvest for very short periods. Additional permits are required for harvests within the Chesapeake Bay Critical Area and other areas specific to certain counties. Each of these additional permits is valid for differing time periods, thereby further complicating the harvest process. Green building regulations give points to builders of state-sponsored projects who use locally sourced lumber, thus reducing greenhouse gas emissions. However, this market has not been accessible to most Maryland forest landowners, who cannot obtain certification because it is cost prohibitive for small woodlots. As a consequence, the sale of Maryland lumber for green construction has been stagnant. Recent changes in policy by the Maryland Green Building Council improve this situation.

The future of sustainable farming and forestry in Maryland will be significantly influenced by the confluence of relevant public policies and private sector investment in the industries. Relevant policies include those concerned with land use and preservation; support for resource-based businesses, including value added agriculture and direct marketing enterprises; and environmental regulation. How these policies come together will affect different industry sectors in different parts of the state, in tandem with continued effects of land development and fragmentation (Chapter 4). For example, sustainability of one agricultural sector—commodity-scale poultry on the Eastern Shore—may in part depend on limiting further impacts of development, and in part on continued evolution of nutrient management policy in ways that support profitability while adequately limiting pollution. Impacts of development include a) residential neighbors that compromise production and litter disposal on cropland in a variety of ways, and b) conversion of remaining cropland to levels that might be insufficient to produce adequate feed, dispose of poultry litter, and avoid the need to import feed from other regions and transport litter to the Western Shore.

This example illustrates the need for a geographic-specific confluence between farmers, other industry stakeholders, counties with land use management authority (in this example on the Shore), and relevant environmental policies. It is important because anticipated return on future industry investment will depend on reasonable expectations about land use, the ability to produce and process birds and bird feed and dispose of litter, and the environmental regulatory playing field.

As population and development continue to expand, this kind of confluence between private objectives (e.g., profitability) and public objectives (e.g., water quality) becomes increasingly essential. In the absence of deliberate confluence, the industries can only react to what happens in the landscape and marketplaces around them. Under that scenario, the sustainability of some industry sectors may be compromised or lost in some parts of the state, as has already occurred in limited circumstances up until now. Exactly what will happen where is anybody's guess, but Chapters 3 and 4 suggest some possibilities.

If there is an over-arching recommendation indicated by the findings and conclusions of this report, it is that Maryland's public policy should evolve explicitly both to achieve public objectives of interest and to inform and support private sector investment in these two industries, through a collaborative process.

Conclusions and preliminary answers to the three fundamental questions posed in the project are found in Chapter 4. Those questions are:

1) Where do Maryland farming and forestry appear to be headed under existing trends in key external factors affecting market access and

preferences, industry efficiency, profitability and land use change?

2) Where (geographically) and what kinds of farming and forestry might be most affected by land use changes and recent environmental and policy initiatives in Maryland, and which might be most sustainable?

3) How might public policies be adapted to minimize negative and maximize positive effects of Bay restoration, smart growth initiatives, and important externalities on the sustainability of farm and forest production and marketing options?

Introduction

About the Study

In June 2014, The Harry R. Hughes Center for Agro-Ecology, affiliated with the University of Maryland, commissioned the authors to study possible sustainable futures for Maryland farming and forestry over the coming decades. Of particular interest to the Center were effects of policies recently enacted as part of the Chesapeake Bay Restoration and smart growth initiatives, respectively. Specific policies of interest included the Chesapeake Bay Watershed Implementation Plan; nutrient management regulations; the phosphorus management tool; the Economic Growth, Resource Protection, and Planning Act of 1992; the 1997 Priority Funding Areas Act; the Agricultural Stewardship Act of 2006; and the Sustainable Growth and Agricultural Land Preservation Act of 2012.

Agriculture and forestry in Maryland have changed dramatically many times in the state's history. At any point, some parts of the agriculture sector were gaining or losing market share or profitability due to changes in consumer preferences, technology, prices and price supports, etc. Agriculture and forestry were also affected by new settlement patterns, infrastructure and population growth. Laws and regulations shaped by government at local, state and federal levels, as well as changes in markets and trade policy, have also profoundly affected the path of farming and forestry from the colonial period onward. Responding to these external and internal forces, some aspects of one or both industries have risen and fallen several times. Some dominated for a time and were eclipsed (e.g. vegetable canning and tobacco). Some started from humble beginnings and have become huge industries (e.g. poultry). No doubt, in every era, there was concern when some types of production or markets expanded or contracted.

The most recent set of policies and regulations to protect the Chesapeake Bay and to reduce the conversion of farm and forest lands to development have added a new set of challenges for agriculture and forestry. As a result, concerns about the future of these industries are being voiced anew. For our study, we chose to examine past and potential effects of both the public policies of interest and some external factors that continue to play important roles in determining sustainable futures for the industries.

The Status of Agriculture and Forestry in Maryland

Maryland's soils and climate are well suited to farming and forestry. But farming and forestry are businesses, and as businesses they are faced with the same types of market and regulatory challenges as other businesses. As a result, farms in East Coast states have lost competitive advantage in most types of agricultural production. In fact, the United States as a whole in the last few decades has ceded some of its competitive advantage to countries with low wage structures. In part, this is due to trade agreements, which work for comparative advantage by exporting high technology products and importing low wage products such as fruit and vegetables.

Farming remains viable in Maryland. Market competition and transportation options may have limited farmers' ability to compete in wholesale markets, but retail sales of local farm products show potential. Maryland and the nearby urbanized areas of Pennsylvania, Virginia and Washington, D.C., are home to relatively affluent residents who increasingly want to know where their food comes from and how it was raised. However regulatory, aggregation and distribution issues remain. The poultry industry and its supporting grain industry should remain competitive. The poultry industry is fully integrated and benefits from its nearby source of grain and fields where poultry waste can also be applied.

The forest products industry has been stymied by limited transportation options and access to timber. Trains no longer transport logs from the Eastern Shore. Trucking to and from the Shore is difficult due to heavy traffic and tolls. Fines are stiff for load infractions. Regulations and policies have limited the forest industry's ability to compete in green construction and green energy projects. Permitting policies in some Maryland counties discourage harvesting, and private forestland is increasingly fragmented by development and less accessible to manufacturers.

External Forces Influencing the Future of Agriculture and Forestry

As described in Chapter 1, Maryland agriculture has been influenced profoundly by broader economic and governmental forces, including consolidation of our food systems, globalization, modern farming practices and trade agreements. As a result, most U.S. farms are much larger and less diversified than in decades past. Maryland farms lacked the size, the year-round growing climate, and the labor to compete as these forces affected farming. They lost market share for vegetables, fruit, dairy, beef and pork as the food industry sought out the lowest priced goods in the competition for consumers. For similar reasons, the forestry industry lost market share to the forests of the Pacific Northwest and fast growing tree plantations in the South.

On the other hand, two economic trends have benefited Maryland agriculture: the concentration of poultry production on the Delmarva Peninsula (which helps both grain and poultry farmers); and the local food movement, which has benefited farmers engaged in the direct sales of locally grown and produced vegetables, fruit, dairy products, meat, wine, beer, etc.

Chapter 2 highlights the region's efforts to restore the Chesapeake Bay and how those efforts have both helped to protect farm and forest land and have raised questions about the future viability of the industries due to Bay-saving regulations.

Another force predicted to impact Maryland agriculture in the twenty-first century is climate change, which is expected to make Maryland's climate warmer and wetter. An indirect benefit to Maryland may be a bigger market share if California continues to dry up from drought and altered weather patterns. Trade agreements may reduce market share while war, terrorist actions or regionalism may stimulate a movement toward more food sovereignty.

Population growth and nutrient loads have already compromised water quality in the Chesapeake Bay. Efforts to undo damage to the estuary have made some progress while raising concerns that some of the regulations put farmers at a competitive disadvantage. Population growth in Maryland has also meant conversion of more resource land to development, and more intrusion of residential population and associated impacts on farm and forest businesses. Chapter 3 provides a prognosis for future impacts of growth and effectiveness of smart growth policies.

In this study, we examined ways in which external factors such as those mentioned above and governmental policies of interest have impacted farm and forest industries in the past, and are likely to do so in the future. In Chapter 4, we also consider how Maryland's policies might better support profitable industries, environmental integrity and the human communities that depend on both.

Research Methods

The objectives of the project were to answer the following questions in the context of the economic, environmental and land use policy issues discussed above:

- Where do Maryland farming and forestry appear to be headed under existing trends?
- Where (geographically) and what kinds of farming and forestry might be most affected by recent environmental and policy initiatives in Maryland?

- How sustainable might various kinds of farming and forestry be under likely future land use, market, economic and regulatory scenarios?
- How might public policies be adapted to minimize undermining—and maximize the positive effects of policy initiatives and economic forces related to—the sustainability of farm and forest production and marketing in Maryland?

To achieve the objectives, the following methods were employed:

GATHER AND EVALUATE INFORMATION to determine where Maryland farming and forestry appear to be headed under existing trends, and what kinds of farming and forestry may be the most affected by recent environmental and land use initiatives.

We evaluated the implications of nutrient management requirements, the phosphorus management tool, Maryland's Critical Areas Program, Maryland's Forest Conservation Program, local land use regulations, and health/food safety regulations on sustainability of farming. To do so, we relied on two primary categories of information:

- Publications, completed research reports, and statistics: The team searched published research and report documents to gather information about Maryland agriculture and forestry and the national and international context in which Maryland agriculture has evolved. We leaned heavily on the Agriculture and Forestry consultants on the project team, met with experts, and asked for lists of references. Team members attended two conferences where new research and perspectives were presented (Future of Eastern Shore Agriculture Conference and the Phosphorus Symposium). We were fortunate that the Maryland Sustainable Growth Commission's subcommittee on forestry was highly active during our research phase and created valuable information of which we took advantage. In the instance of the Phosphorus Management Tool (PMT), we engaged Dr. Erik Lichtenberg of University of Maryland (UMD) as a project consultant to complete an analysis of the projected economic impact of implementing the PMT on grain and poultry agriculture on the Eastern Shore.

- Interviews with industry experts, producers, agencies and academics: The team interviewed 29 individuals from various sectors of the agricultural and forestry communities. Our intent was to add the insights and interpretations of people involved in the core issues of the study: environmental regulations, the changing resource land base, and market and technology trends affecting agricultural and forestry industries. We asked interviewees to offer their perceptions of these key elements and their assessment of how the resource-based industries are responding to current trends and are likely to in the future.

Individuals interviewed included commodity and table crop producers, dairy and beef producers, specialists at Maryland Department of Agriculture (MDA) and UMD research and extension, financial lenders, poultry integrators, associations, forestry experts and agricultural media. For efficiency's sake, we looked for individuals who could speak from several perspectives, such as being from an agency and being a producer or a young farmer.

The following questions were asked during interviews of agricultural industry stakeholders:

1. What type of agricultural enterprise are you involved with? Is it profitable and sustainable for you, and do you anticipate being able to stick with it for some time?
2. What factors are affecting the stability, profitability, expansion or contraction of your business, and do you expect these things to change? If so, how? (e.g. markets, consolidators/distributors, wholesale/retail marketers, consumer markets, local markets, federal/state/local regs)

3. Does land conversion to development have any effect on your business, if so, what? (e.g. lack/cost of land, intrusive residents, complaints, traffic, too many conflicts, threat of litigation, interference with business)
4. Do land use regulation and/or land preservation practices of local or state government affect your business, if so, how? (e.g. zoning restrictions on farm/income producing activities, easement programs)
5. Are environmental regulations and requirements relating to water pollution control, the Chesapeake Bay restoration, nutrient management, the phosphorus management tool, or stream buffer and fencing requirements for livestock affecting your business? If so, how?
6. What changes/innovations are coming from within the industry that could affect the profitability and/or environmental performance of agricultural operations and businesses in your sector? (e.g., value-added enterprises, genetics, precision farming, fertilizer management and products, technology, pollution control practices, etc.)
7. Are health regulations, restrictions or requirements affecting your business, and if so, how? (e.g. local, federal, state; production/safety; handling; slaughtering; processing; distribution)
8. Are wholesale, retail, local, regional or global markets for food products changing in ways that affect you? How?
9. Are there state, local or federal policy changes that would better support sustainable and profitable business for you and others engaged in similar or related endeavors? Please elaborate.

Information from both publications and interviews is used throughout Chapters 1 and 2 to highlight the analysis and ground it in the observations of those who are involved in and affected by the changes, and in Chapter 3 to compare research findings to experiences of industry people.

ESTIMATE FUTURE LAND USE CHANGE AND ITS IMPACTS: Estimate where and how much expected future residential development is likely to convert and fragment agricultural and forest lands; which kinds of production options will be most compromised, and where; and how relevant public policy initiatives will influence the process and outcome. Consider potential impacts of climate change and implementation of Best Management Practices (targeted in Maryland's Watershed Implementation Plan for the Chesapeake Bay Total Maximum Daily Load, or TMDL) on potential losses or gains of farm and forest land. The research methods used to these ends are described in detail in the last section (3.4) of Chapter 3.

STAKEHOLDER REVIEW OF PRELIMINARY REPORT: Prepare and distribute preliminary report to selected stakeholders, to better inform findings, conclusions and recommendations. We distributed a preliminary draft of the report to many of the industry experts that we interviewed and an additional 13 individuals that we invited to comment. All comments were evaluated and discussed among investigators and/or consultants, and most resulted in changes to improve the report.

The Role of Public Policy in the Future of Agriculture and Forestry

As world population has increased, human impacts have created environmental disasters and threatened others. In response, proactive governments have promulgated regulations and created programs to find solutions and protect the commons (air, water and lands) from excessive damage and exploitation. The Dust Bowl of the 1930s brought about soil conservation programs. Rapid loss of Maryland farmland in the 1950s to suburban development brought about the nation's first agricultural use assessment law in 1960. It is now considered to be an essential tool for retaining farm and forest land. The Cuyahoga River fires helped to bring about the Clean Water Act, and smog in major U.S. cities brought about the Clean Air Act in the 1970s.

Through land-grant university research and effective public policy, farm and forest productivity

has increased dramatically over the last century. But public policy change and scientific innovation can create unanticipated consequences. They need to be evaluated continuously to see that they are balanced, and that the regulated industries and the rights of individuals are not undermined by well-intended regulations or technologies.

Population growth and nutrient loads have already compromised water quality in the Chesapeake Bay and its tributaries. Expanding development has accelerated conversion of resource land and intruded on farm and forestry businesses. Regulatory efforts to undo damage to the estuary have made some progress but raise concerns that they are putting farmers at a competitive disadvantage. Improved land use policies have been effective in some capacities, but not enough to reverse historic declines in significant aspects of both agricultural and forest industries.

This paper examines these concerns. It also examines ways in which external factors have impacted these industries in the past and are likely to do so in the future, and how Maryland might respond through policy to better support both profitable farming and forestry and the common good.

Chapter 1: Where Do Maryland Agriculture and Forestry Appear to Be Headed?

At the time of the 2012 USDA Census of Agriculture, Maryland agriculture appeared on paper to be in a good place. The total market value of crops had increased 28 percent since 2007. Meanwhile, total farmland in production had nearly stabilized, acres decreasing only one percent over the five-year period.

However, Maryland farmers have a sense that they are under siege, and there is some justification for that sentiment. Zoning and "smart growth" regulations have been adopted that limit sale of their land for development, raising the concern that their farms have decreased in value. New environmental regulations are being promulgated at an ever-increasing rate. Farmers rightly worry that Maryland's drive to be the state that sets the standard for Chesapeake Bay cleanup may put its agriculture and forestry industries at a competitive disadvantage with other parts of the region, the country and the world.

Before one can begin to forecast the potential impacts of smart growth and environmental regulations on the future of sustainable agriculture and forestry, it is important to consider historic and emerging trends and what is driving them.

1.1 Historic Trends in Agriculture

European colonization of Maryland was enabled by resource-based industries. The Americas were supplying the raw materials for a growing European population. Maryland had a mild climate and an abundance of natural resources.

Over the centuries, farm and forest industries have competed for available land. Farmers cleared forests when farming was profitable and farmland reverted back to forest when it was not.

In the early years, colonists tried exporting a wide variety of products for European consumers.

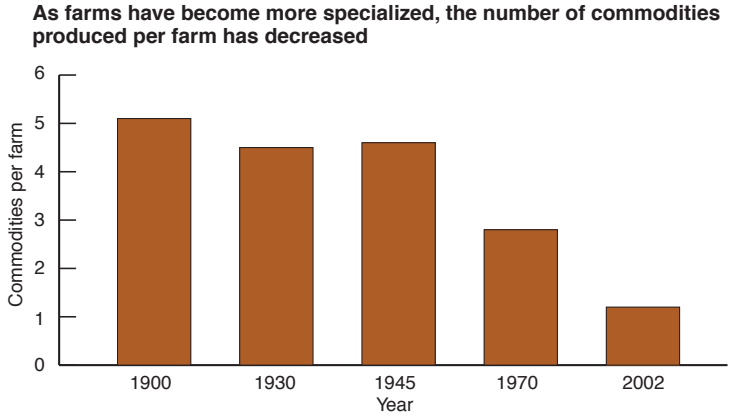
Ultimately, farmers settled on tobacco. There was huge demand for the "sot weed," and it was one export commodity that could endure the long trip back to Europe.[1] The Chesapeake region became known as the Tobacco Coast. Food was grown for farm families and for residents of the state's small towns, but tobacco was the money crop.

With the Industrial Revolution, towns and cities expanded dramatically to supply labor to factories. Maryland farmers provided their urban customers with fresh produce, dairy products and meat. Farms and fisheries also supplied the mills and canneries (peaches, tomatoes, oysters, crabs, etc.), which extended product shelf life. The first cannery opened in Baltimore in 1849, and by 1880, Maryland was the canning center of the country. The railroads transported Maryland farm goods up and down the East Coast.

1.1.1 Twentieth Century Food Business Innovation and Trade Policies

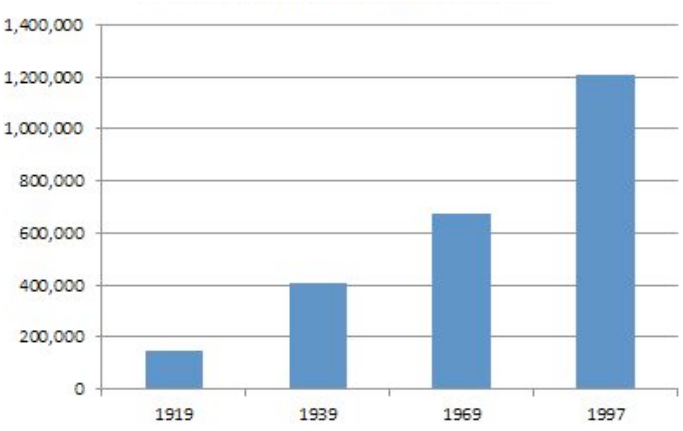
The beginning of the twentieth century found Maryland farmers operating much the way farmers operated in the nineteenth century. Farms were highly diversified. They sold, traded, and

Figure 1.0-1: The 20th Century Transformation of U.S. Agriculture and Farm Policy/EIB-3 Economic Research Service/USDA (page 5)



Note: The average number of commodities per farm is a simple average of the number of farms producing different commodities (corn, sorghum, wheat, oats, barley, rice, soybeans, peanuts, alfalfa, cotton, tobacco, sugar beets, potatoes, cattle, pigs, sheep, and chickens) divided by the total number of farms.
Source: Compiled by Economic Research Service, USDA, using data from *Census of Agriculture, Census of the United States,* and Gardner (2002).

Figure 1.0-2: California acres of Vegetables USDA Census of Agriculture



consumed the goods that they raised. Local mills processed grain. Canneries processed surplus vegetables and seafood. Slaughter facilities processed local meat. The state was virtually food self-sufficient. However, farms in the U.S. became more specialized during the twentieth century (see figure 1.0-1), and Maryland was no exception.

According to the 1920 Census of Agriculture, Maryland was the 6th largest supplier of vegetables for sale in the U.S. Gradually, the canning industry expanded to other parts of the state, particularly the Eastern Shore, where it was going strong through the 1950s. As recently as 1939, Maryland had the equivalent of 29 percent of California's acres in vegetable production, even though California is a much bigger state.

BUSINESS MODEL FOR GROCERY STORES CHANGES THE FARMING INDUSTRY

Before supermarket chains, most food was locally produced. Some was sold by vendors on the streets and at outdoor markets, like Lexington Market in Baltimore City. Mom and pop stores supplied more shelf-stable foods such as canned and dried goods sourced from small- and mid-sized industries in the region. Butcher shops supplied meats.

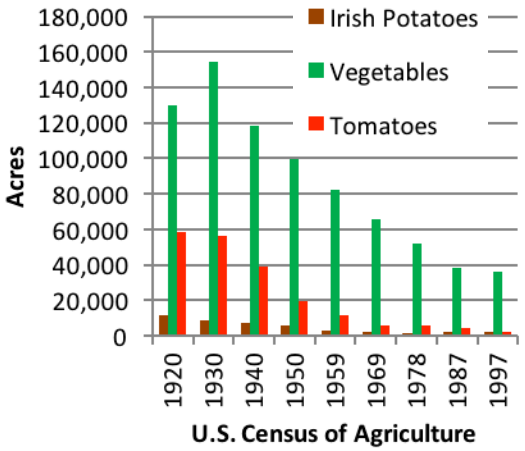
A new model for supplying food emerged in the 1920s. A few food chains (multiple grocery stores under the same ownership) that existed at the beginning of the century began to ask wholesalers for discounts based on volume. Then some companies started operating their own warehouses to further reduce costs and speed up re-shelving. Finally, some of the largest companies began to manufacture their own store brands and run their own trucking divisions. By doing so, they could price their products well below mom and pop competitors. In the 1940s the federal government sued the first major supermarket chain (A&P) under antitrust laws, fearing that it would become a monopoly. Ultimately, the federal government won the case and the company owners were fined.[2]

However, consumers liked the lower prices and eventually accepted the supermarket chain model. Tens of thousands of local grocery stores closed in the next few decades as major companies took hold of the market, but they were not the only losers. As chains grew larger, they began to aggregate food from greater distances, seeking the lowest prices for consumers. California, with its temperate climate, great soils and irrigation systems became the food basket of the nation.

The first national survey of food stores in 1929 reported 585,980 stores,* which served 121 million

* U.S. Census Bureau's *Statistical Abstract of the United States.*

Figure 1.0-3: Maryland Specialty Crops Acres in the 20th Century



residents. As recently as 1939, supermarkets sold only 10 percent of all food.[3] According to the 1940 Census of Agriculture, Maryland farmers grew over 200,000 acres of vegetables, tomatoes and potatoes. Farms were highly diversified, with 68.5 percent selling or trading livestock, 37.9 percent selling or trading dairy products and 31.6 percent selling or trading vegetables. Their market share and level of farm diversity declined in every decade that followed. Like other East Coast states, Maryland was not able to compete with the wholesale food production in the West.

By the end of the twentieth century, there were 163,000 grocery stores serving 282 million residents in the U.S., including 24,600 supermarkets.* The latter were responsible for 95 percent of all sales. The new food business model had reduced food costs and provided a much greater diversity of products. It also changed farming in the U.S., leading to much less on-farm product diversity and greater specialization. According to the 1997 Census of Agriculture, California was producing 47 percent of all U. S. vegetables, sweet corn and melons, and 61 percent of all fruits, nuts and berries.

AGRICULTURE RESEARCH AND INNOVATION

Signed into law by President Lincoln in 1862, the Morrill Act gave the federal government authority to provide land for colleges, at least one for each state. A leading objective of the act included the teaching of agriculture. The University of Maryland is an example of a land-grant college. Research and education from land-grant colleges had a profound impact on agriculture in the twentieth century.

Research, much of it by such institutions, led to improved farming techniques. Extension programs disseminated information to farmers who readily adopted new ways to produce more efficiently. In 1930, U.S. farmers averaged 30 bushels per acre of corn. By 1974, the average corn yield in the U.S. had risen to 71 bushels per acre, due in large part to commercial fertilizers. With better mechanization, horticulture techniques and breeding, corn yield in the U.S. improved to 118 bushels per acre in 2012.

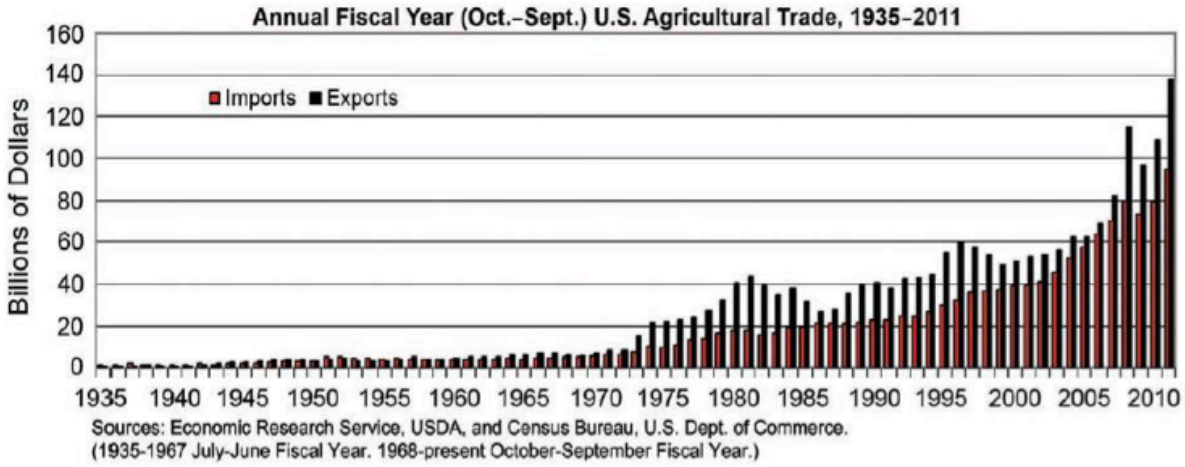
Likewise, genetics and breeding produced incredible increases in livestock production. In 1920, there were 9,125 farms in Maryland producing 29,842,910 gallons of milk. As of 2012, the number of farms with milk cow herds had dropped to 573 according to the USDA census. However, those farms produced in excess of 113 million gallons of milk†. Milk production per cow in the U.S. has increased 241 percent since 1950. Don Blayney reports that the entire dairy industry was transformed during the second half of the 20th century as farms became more concentrated in certain regions, and became more specialized in producing milk.[4]

Fewer farmers were needed to produce the same amount of food. Over-production led to market crashes, jeopardizing farms across the nation. In 1949, Congress approved the Agricultural Act, which established a policy of high, fixed-price supports and acreage allotments as a way to regulate production. In 1954, the act was modified to introduce flexible price supports to commodity programs. In 1965, it was revised to provide new income support payments in combination with

* www.referenceforbusiness.com/industries/Retail-Trade/Grocery-Stores.html.

† Estimated number of gallons of milk is based on number of milk cows according to the USDA Ag Census 2012 times the average number of pounds of milk per cow per year, according to USDA/NASS *Annual Milk Production, Disposition, and Income (PDI) and Milk Production,* various years.

Figure 1.0-4: Imports and Exports from USDA technical bulletin 1935 (page 15)



reduced price supports and continued supply controls.

TRADE

By the 1970s, the focus changed from supplying U.S. markets to supplying global markets. As noted in the USDA report *The 20th Century Transformation of U.S. Agriculture and Farm Policy,* the federal government enacted farm bills providing price supports and income support payments to manage supply and reduce risk for farmers. Then, under the leadership of Earl Butz at the U.S. Department of Agriculture in 1973, Congress adopted the *Agriculture and Consumer Protection Act,* which "introduced target prices and deficiency payments to replace price supports, coupled with low commodity loan rates, to increase producer reliance on markets and allow for free movement of commodities at world prices."[5] The figure below shows the impact of the act on imports and exports.

Maryland grain farmers benefited from the price supports and income support payments, but many were challenged by farm size. To earn enough income, farms had to lease land from other small farms.

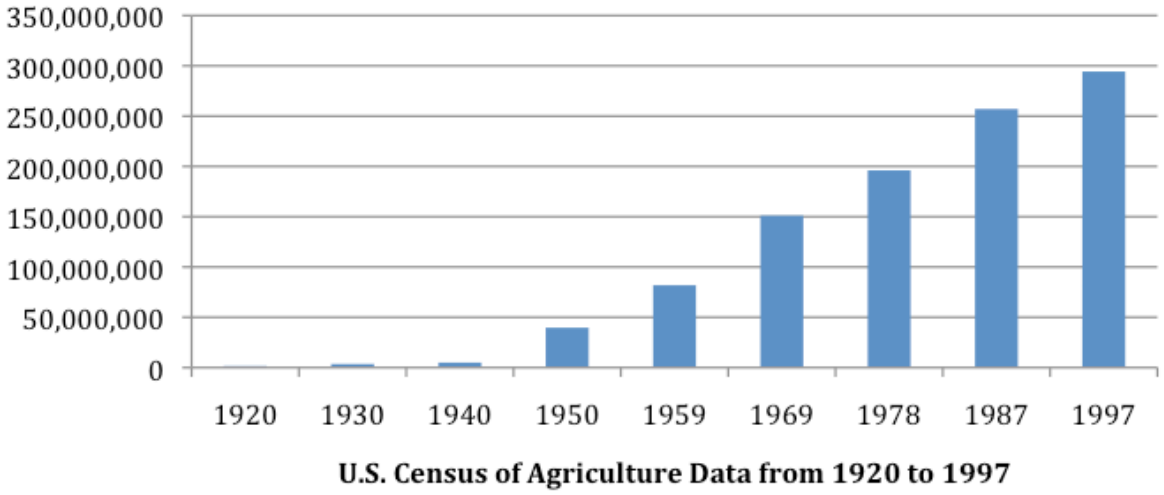
Maryland agriculture ended the century vastly altered from the way it had begun. It had lost its significance as a vegetable and fruit producer. The number of milk cows was half the number of 1920. It had lost its canneries and most of its mills. Acres in corn had dropped by a third and wheat had dropped by two-thirds. The number of cows, hogs and pigs had declined. Meanwhile, three million fewer acres of farmland were in production. Farmland losses occurred in neighboring states and along the whole East Coast.

Between 1910 and 1997, the New England states lost 80 percent of their farmland, New York, New Jersey and Pennsylvania lost 65 percent of their farmland, and the remaining Atlantic Coast states (Maryland included) lost 53 percent of their farmland.

A few farm products in Maryland that benefited from proximity to urban population centers continued to find some success. Horticultural industries continued to supply much of the landscaping materials for homes and businesses. The equine industry continued to supply pleasure horses and race horses for the region.

Only one traditional Maryland agricultural product was really on the upswing: poultry. The 1920 census reported that 37,194 farms raised 4,597,201 chickens. The 1997 census reported that there were 1,096 farms raising 294,314,818 broilers and other meat-type chickens (See figure 1.0-5.).

Figure 1.0-5: Broilers and Other Meat Type Chickens Sold



U.S. Census of Agriculture Data from 1920 to 1997

1.1.2 Maryland Agriculture in the Twenty-first Century

Since the turn of the twenty-first century, Maryland agricultural land has begun to stabilize. After losing roughly 34,500 acres per each five-year agricultural census between 1910 and 1997, Maryland lost only 8,275 acres per year between 1997 and 2012, and the market value of agricultural products sold increased by 66 percent (or 15 percent, inflation adjusted).

As per the 2012 Census of Agriculture, Table 1-5 is the ranking of Maryland Ag Products sold.

Table 1-5: Maryland 2012 Census of Agriculture

	Farms	Sales ($1,000)	Rank by Sales in MD	Percent of Total Sales
ITEM				
Total Sales	12,256	2,271,397	(X)	100.0
Poultry and eggs	1,688	922,999	1	40.6
Grains, oilseeds, dry beans and dry peas	3,769	716,348	2	31.5
Nursery, greenhouse, floriculture and sod	535	204,808	3	9.0
Milk from cows	463	187,497	4	8.3
Vegetables, melons, potatoes and sweet potatoes	797	70,711	5	3.1
Cattle and calves	2,663	69,917	6	3.1
Other crops and hay	2,507	35,806	7	1.6
Fruits, tree nuts and berries	476	20,065	8	0.9
Horses, ponies, mules, burros and donkeys	661	13,188	9	0.6
Hogs and pigs	340	(D)	10	
Aquaculture	25	9,011	11	0.4
Other animals and other animal products	353	(D)	12	(D)
Sheep, goats, wool, mohair and milk	795	(D)	13	(D)
Cut Christmas trees and short rotation woody crops (See 2012 Census for full description)	151	1,792	14	0.1
Tobacco	43	1,026	15	(Z)
Cotton and cottonseed	-	-	-	-

While farm sales totaled roughly $2.3 billion in 2012, Jeffrey Ferris and Lori Lynch[6] note that "in 2010, the agricultural sector accounted for over $4.7 billion in direct output and over 22,000 jobs. Indirect and induced impacts from the agricultural sector added another $2.03 billion to the Maryland economy."

On the other hand, putting Maryland's agriculture industry in perspective, its farms are 0.50 percent of total U.S. farms. Its acres of farmland are 0.2 percent of all farmland acres. The market value of its agricultural products are 0.55 percent of total U.S. farm products, and its top agriculture products (poultry and eggs) are 2.2 percent of the total U.S. poultry and egg production according to the 2012 U.S. Census of Agriculture. Agriculture is an important industry in Maryland, but a small part of this vast agricultural nation.

Maryland's Top Four Maryland Ag Products

Maryland's agriculture industry is diversified, with four major categories generating over $100 million each. Below is a summary of all four top products and how they have been faring in the twenty-first century.

POULTRY

The poultry industry is Maryland's top income producer. It was borne out of a shipment error in 1923 on a little farm in Delaware. Farmers in the area raised poultry to sell eggs. Older layers were used for meat. Cecile Steele of Bethany Beach, Delaware, ordered 50 chickens from Vernon Steen and she received 500. She decided to keep the excess and raise them to sell for meat. Eighteen weeks later she sold 387 survivors for a significant profit to a local buyer who shipped them north. Her next order was for one thousand chicks. Her husband left the Coast Guard to build chicken houses. The people of southeastern Sussex County found a needed source of income.[7]

Likewise, farmers on the Eastern Shore of Maryland were also looking for a new farm product to revive the agricultural economy. And the idea spread. Chicken sales grew 422 percent between 1920 and 1940.

The ultimate success of the Delmarva broiler industry came from the development of a relationship with grain farmers, access to markets, and eventual vertical integration of the entire supply chain. As the broiler market began to grow in the 1930s, Delmarva farmers were producing only 20-30 bushels of corn per acre and the broiler industry was importing special feed for the birds. However, it was discovered that chicken manure that was removed from the houses and discarded on farm fields had a profound impact on grain productivity. Soon, there was enough grain to supply the growing broiler industry.[8]

As the industry grew, so did the number of dealers and brokers; access to major cities was a major advantage. Vertical integration began in the 1940s when feed companies and hatcheries began contracting with growers. Then in the 1950s, the first company successfully combined breeding, milling, broiler-growing and processing—full integration of the supply chain. With close access to grain, the ability to return poultry litter to the fields, nearby markets and full integration of the system, Delmarva is able to compete in local, regional and global markets.

Scientific research and outreach from the region's land-grant universities have also been pivotal. The Universities of Maryland, Delaware and Virginia have played a role in breeding, feeding, controlling diseases, marketing, promoting food safety and bringing industry representatives together to take on industry issues.

Maryland's portion of the Delmarva Peninsula has been very successful. Perdue Farms Inc. is currently the fourth largest broiler company in the U.S. Other companies operating in Maryland include Allen Harim Foods LLC, Amick Farms, Mountaire Farms, and Tyson Foods, Inc.

Perdue Farms has been an industry leader over the decades. It was one of the first to fully integrate its production. It built the first hatchery in Maryland, the first soybean processing plant, and the first poultry processing plant. Frank Perdue changed

the way poultry was marketed. At the time, it was unusual for a manufacturer to advertise, and Frank Perdue became the first CEO to personally market his product. Recently, Perdue Farms jumped into the organic market, anticipating growing consumer demand.

By the end of the twentieth century, concerns were being raised about the impact of over-nutrification of waterways, caused in part by poultry manure being applied to farm fields (note that the application rates leading to high phosphorous levels were recommended by university extension at the time). The issue remained unresolved until the adoption of the Phosphorus Management Tool following the 2015 legislative session of Maryland's General Assembly. Thus far, it has not deterred expansion of the industry. New poultry houses were being built at a rapid rate in the beginning of 2015, and the companies have been providing extra financial support for their construction. If poultry waste issues are successfully addressed in Maryland, it may even give the state a competitive advantage over states that have not addressed nutrient pollution and know they will eventually be required to meet requirements of the Clean Water Act.

As long as the industry continues to innovate, keep up with consumer preferences and manage its environmental impact, its prospects are good.

GRAINS, OILSEEDS, DRY BEANS AND DRY PEAS

The future for grains in Maryland, particularly the grain farms on the Eastern Shore, is tied to the poultry industry. To be profitable, the grain industry needs a strong, reliable market. The increase in worldwide consumption of chicken has created robust and diverse markets for which Maryland's integrators have taken full advantage. Strong demand and the relative proximity of the grain has meant that integrators can offer a higher price than Eastern Shore grain producers could get from the Chicago Commodity exchanges. The poultry industry mills its own grains and, luckily, buys over 80 percent of the grain produced on the Eastern Shore. In addition, production costs for many grain farmers have been lowered by their use of readily available poultry litter for fertilizer. A second key requirement for supplying global grain markets is a good local port. The loss of grain docks in the Port of Baltimore has meant that other ports are receiving Maryland grain, and this could affect the state's market share in the future.

The greatest threat to the grain industry may be access to land. As per the 2012 Census of Agriculture, 64 percent of all Maryland farmland is leased, compared with the national average of 40 percent. The average farm size in Maryland is 166 acres—this is the mean; the median is 50—and grain farmers need 1,000+ acres to earn full-time wages. Grain farmers compete for land with other farmers and with non-farm uses. Further fragmentation of farmland would impact the viability of the grain industry, and that might impact the viability of the poultry industry.

As one organic grain producer said, grain farmers need land in large blocks to operate our combines, trucks, cultivators, etc. and move from field to field, farm to farm even if its dusty or on a late, wet night with lights. This is of ultimate importance to all agricultural producers.

NURSERY, GREENHOUSE, FLORICULTURE AND SOD

This is one farm industry that appears to benefit from suburban development. New residential development is usually accompanied by street trees, lawn trees and bushes, sod and summer flowers and gardens. In the second half of the twentieth century, these products represented the highest value farm product in many of the Western Shore counties near urban areas, including Anne Arundel, Baltimore, Montgomery and Prince George. Nurseries and greenhouses can "fit" better—socially and spatially—on farmland fragmented by development, much more so than poultry and grain. In general, they cause few nuisances for residential subdivisions, and the residents are potential customers.

As the sales of nursery, greenhouse, floriculture and sod products are seasonal, national corporations have been less able to corner the market, so many of the operations are locally owned. Another factor that has discouraged

corporations from making major investments in the industry is that it is so dependent on new development, as suggested by the drop in sales between 2007 and 2012, from $208,692,000 to $204,808,000, which coincides with the downturn of development during the recession.

A 2012 survey from the Maryland Nursery, Landscape and Greenhouse Association reported that gross receipts were estimated at $1.19 billion in 2012 and expected to increase to $1.3 billion in 2013. Retail sales accounted for 25 percent of gross receipts in 2012, landscape installation and maintenance accounted for 46 percent, and growers' sales (both wholesale and retail) accounted for 29 percent. The survey reported that total acres in nursery production exceeded 29,980, including 495 acres of covered space. In short, it is a farm industry that is tied to the economic fate of the housing industry.

Participants identified the following factors limiting growth:

- Financial Resources/Economy — The continuing depressed/recessed housing market and general economy make it difficult for the industry to grow,
- Taxes and regulations reduce profits,
- Labor — quality and quantity, as well as immigration, were important factors, and
- Competition — likely made worse due to the weak economy.

MILK FROM COWS

While the dairy industry is the state's fourth largest revenue producer, it has been on a long decline. Between 1975 and 2012, the state's market share of U.S. production dropped from 1.3 percent to 0.49 percent, and total milk production from cows has decreased from 1.5 billion pounds to 979 million pounds, a 35 percent decrease.* Over the same period, Virginia's milk production declined 2 percent and Pennsylvania's milk production increased 47 percent. However, even Pennsylvania lost U.S. market share, decreasing from 6.2 percent to 5.2 percent.

According to McDonald and Newton,† U. S. milk production has shifted to large operations. Farms with greater than 999 cows produced 10 percent of U.S. milk in 1992. In 2012 those farms produced 49 percent of U.S. milk. Meanwhile, U.S. milk production on farms with less than 100 cows dropped from 49 percent to 17 percent. In Maryland, 68 percent of all dairy farms have fewer than 100 cows and only 9 had 500 or more cows, according to the 2012 census. On the other

* 1975 data is from USDA ERS 978 and 2012 data is from the USDA/NASS *Milk Production Report.*

† James MacDonald and Doris Newton, "Milk Production Continues Shifting to Large Scale Farms," *USDA Amber Waves,* December 1, 2014.

hand, the Pacific Coast states have seen growth in market share, from 12.3 percent to 41.93 percent between 1975 and 2012. California was the largest state producer of milk in the U.S. in 2012, and it had 992 dairy farms with 500 or more cows.

Land costs and access to land may be a factor for dairies trying to scale up in Maryland. The state has higher land values than Pennsylvania and Virginia ($6,930, $5,425 and $4,306 respectively according to the 2012 U.S. census). Also many of the counties in Maryland that had numerous dairies in the twentieth century have experienced significant development in their rural areas. In Chapter 3, we report on animal production trends for Maryland counties that have experienced high fragmentation of farmland.

Industry trends have also tightened market opportunities. On June 2, 2014, USDA's *Amber Waves* reported that per U.S. capita, consumption of dairy products dropped 18.6 percent between 1970 and 2012. Increasingly, the U.S. dairy industry has relied on global markets to support its products, but those markets can be affected by climatic and man-made market shifts. For example, Bloomberg Business reported in September 2015 that "The world is awash in milk, with global trade in whole milk powder at its lowest since 2011, the U.S. Department of Agriculture says. For the first seven months of 2015, American dairy exports were down 28 percent, compared with the same period in 2014, says the U.S. Dairy Export Council; the USDA expects purchases of whole milk powder by China, the world's biggest dairy importer, to drop 40 percent this year. The former No. 2 importer, Russia, has banned imports from not only the EU, but also the U.S. and Australia in retaliation for sanctions imposed to protest Russian intervention in Ukraine."*

Two trends may provide some small consolation to Maryland's dairy farmers. First, the state has better rainfall than much of the West Coast, which had seen so much growth in its dairy industry since 1975. Dairy farmers in Maryland can produce their own grass and hay most of the year, and that may be an advantage as the climate heats up. In addition, grass-fed, management-intensive grazing operations pose less financial risk.

J. C. Hanson et al[9] report that, in the Mid-Atlantic region, management-intensive grazing (MIG) operations "were more profitable on per hundredweight, per cow, and per acre bases and were no less profitable on a whole-farm basis. Although confinement operators had higher gross income than MIG operators, their expenses tended to be greater than or equal to those of MIG operators. Profits of MIG operations were less variable as well, so that MIG operators faced less income risk. Increased reliance on grazing was associated with improved animal health, as reflected in lower veterinary, breeding and medicine costs per cow and greater income from the sale of animals. The MIG operators were less labor intensive as well. Lower capital and labor requirements, lower variable expenses, and lower income risk make intensive grazing systems attractive for new entrants to the dairy business. Stricter environmental regulations may increase their attractiveness as well."

Second, farmers pursuing the locally sourced retail market are finding some success in Maryland. The Maryland Department of Agriculture's Ice Cream Trail has been popular. South Mountain Creamery in Frederick is delivering to customers as far away as Annapolis. Nice Creamery in Caroline County delivers milk, yogurt and ice cream to markets on the Eastern and Western Shores. Kilby Cream has a thriving ice cream business in Cecil County and also delivers dairy products. Many of the newer dairies are raising their cows on grass most of the year, and farming practice is preferred by a growing number of customers.

Prospects for the remaining agricultural products listed in Table 1-5 will be addressed in Emerging Trends.

* Einhorn, Bruce et al, "Dairy Farmers at the Barricades," *Bloomberg Businessweek,* September 10, 2015.

1.2 Historic Trends in Forestry

Before Maryland was colonized, nearly all lands were forested. Extension Agent Jonathan Kays reports that clearing for agriculture reached its peak in the 1850s. "After the Civil War, there was a gradual increase in the number of forested acres as agricultural land was abandoned and people moved to industrial centers for jobs. Even more important was the construction of railways. The first railway reached Baltimore in 1830, and with it came the ability to transport huge logs over land to distant markets. Western Maryland became a major exporter of forestry products, and still is. And now, large trucks can haul from places where the trains don't go.

"On the Eastern Shore, Salisbury had deep water access from the Wicomico and the Nanticoke Rivers. When the Eastern Shore Railroad Company extended a line to the southern end of the Delaware line in 1860, Salisbury had two reliable means of transporting lumber. Additional rail access came with the Wicomico and Pocomoke Railroad and the Baltimore, Chesapeake, and Atlantic Railroad, completed in 1891. Salisbury and the region could export and import lumber to Baltimore and along the East Coast."

According to Maryland Forester Daniel Rider, "in 1914 the 2.2 million acres of Maryland's forest supported 3.8 billion board feet of timber, which in turn fed a highly respected and valued industry of 800 sawmills, and 300+ wood-based manufacturers and ancillary businesses. Significant even by today's standards, 16,790 people relied on forest products for their wages, making it the second-largest single industry in the State. Loggers produced 229 million board feet of logs, with hardwoods comprising 129 million board feet and pine accounting for the other 100 million board feet. Lumber products only accounted for 40 percent of the annual timber harvest, with the majority of the harvest (60 percent) processed into pulpwood, railroad ties, piling, cordwood (i.e., fuel wood), tanbark, staves, shingles, lath, and charcoal."

In his report *A 100-Year Comparison of Maryland's Forest Products Industry*, Rider notes that there is even more capacity today to produce forest products than at the beginning of the twentieth century. "Additional farmland abandonment occurred after the Great Depression in the 1930s. Fields reverted to pine and hardwood forests, many of which exist today. These 60- to 90-year-old even-aged forest stands are rapidly reaching maturity."[10]

In 2013, Maryland had an estimated 2.2 million acres of timberland[11]—roughly the same number of acres in forest as of 1914. Timberland is defined as land producing at least 20 cubic feet of wood every year that could be available for harvest. It does not include federal and state park land or Christmas tree farms. The 2013 study indicated that the top ten timber species in Maryland forests contain an estimated 22.5 billion board feet of saw timber, which represents a resource base that will be available for many years into the future. That volume increased by an estimated 5 percent between 2008 and 2013, indicating that the current harvest and natural mortality in Maryland's forests is more than offset by growth.

Figure 1.0-6: Value Added Contributions of Forest Products Manufacturing (2010)

Source: US Census Bureau *Annual Survey of Manufacturers, 2010*

Industry	Cost of Materials	Value of Shipments[1]	Value Added[2]	Capital Expenditures (new and used)[3]
	(x $1,000)	*(x $1,000)*	*(x $1,000)*	*(x $1,000)*
Wood product mfg	275,252	463,518	186,226	6,203
Furniture & related product mfg	333,953	731,946	393,615	9,543
Paper mfg	613,576	1,101,029	503,383	27,438
Total Forest Products	**$1,222,781**	**$2,296,493**	**$1,083,224**	**$43,184**
++ Forest Products include wood products, furniture and paper manufacturing. Detailed data for Logging and Forest Management was not available.				

1. Value of Shipments is the sum of receipts, billings, or sales.
2. Value Added, simply stated, is the difference between the sales value and the cost of products sold without further processing
3. Capital Expenditures include permanent additions and major alterations as well as new and used machinery and equipment used for replacement and additions to plant capacity. Reported capital expenditures include work done on contract and the costs of assets leased.

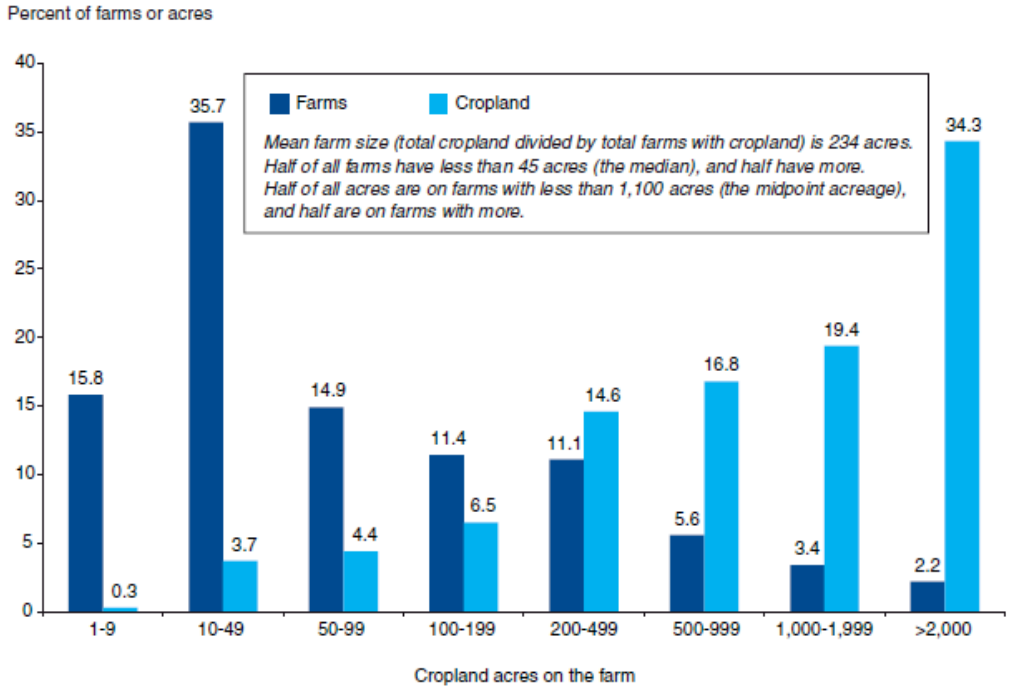
In contrast to agriculture, where farmers can shift crops in response to market signals, the timber that will be available for harvest in 2035 is in the ground today. Some of today's resource may be lost to land use change or a severe disturbance like a pest outbreak or severe weather before it is ready to be harvested, but there will be no new forest planted today that will be ready for harvest by 2030. This makes the forest inventory carried out by the Maryland Forest Service in cooperation with the USDA Forest Service very important in guiding management and industrial investments in Maryland. Having a thriving timber resource base that is available for harvest at some point in the future does not guarantee that major industrial investments will be made, but if it did not exist, they most certainly would not.

In a presentation to the Rural Action Assembly on October 17, 2013 entitled "The Industry of Maryland's Forests," Steven Koehn, then Director of the Maryland Forest Service, reported that forestry currently has a $4 billion impact on Maryland's economy. According to Koehn, lumber, piling and paper are the biggest forest industries, followed by furniture, pallets, cabinets and chemicals. Value-added forestry products represent a significant part of Maryland's economy. As seen in the chart, wood product manufacturing, including furniture and paper, produced shipments valuing $2.3 billion in 2010, according to the U.S. Census Bureau.[12]

According to a recent Maryland Department of Natural Resources (DNR) Forestry Service report,[13] the forest products industry in Maryland employs over 10,000 persons who are compensated $650 million annually.

Forestry has enormous potential but also serious constraints. One key area that is ripe for growth but constrained by policy is supplying the market for certified sustainable forest products to "green" building projects. Such projects are increasingly popular in the private sector, and there are some public buildings that are required by state law be constructed under a green certification process. In the past, the Leadership in Energy and Environmental Design (LEED) standards used by Maryland's Green Building Council (GBC) for rating the sustainability of building projects only accepted lumber certified by the Forest Stewardship Council (FSC). But the FSC process is too expensive for most owners of the hundreds of small tree farms in Maryland to afford. An alternative woodlot certification developed by the American Tree Farm System, which is much simpler and less expensive to obtain, was not

Figure 1.0-7: U.S. Census of Agriculture Cropland Acres



recognized by the MD-GBC or the state. As a result, most Maryland woodlot owners have not been able to take advantage of private green building projects or the state's statutory provisions to encourage builders to locally source sustainable timber products.

However, Department of Forestry discussions with MD-GBC led to amendments in the guidelines for state buildings in the summer of 2015 that now allow credit for materials locally sourced within 100 miles. DNR is working to provide the MD-GBC with a list of Maryland mills and the products they supply so that locally sourced materials can be more readily identified to the council. In 2016, the LEED standards were amended to give credit to both the American Tree Farm System and the Sustainable Forestry Initiative certification standards, so this opportunity should be more available to Maryland forest landowners in the future.

To conclude, the forest industry has a significant impact on the state's economy but is not operating to its full capacity or realizing its full potential.

1.3 Trends in Farm and Forest Tract Size, Operators, Labor and Other Factors

Farming in the U.S. has gone through an astonishing transformation in the last century, from highly diversified to highly specialized. Between 1920 and 2012, the number of U.S. farms shrank from 6.4 million to 2.1 million. Meanwhile, average farm size in the U.S. increased from 148 acres in 1920 to 434 acres in 2012. Over the same period, Maryland went from 47,908 farms to 12,256 farms and average farm size increased from 100 acres to 166.

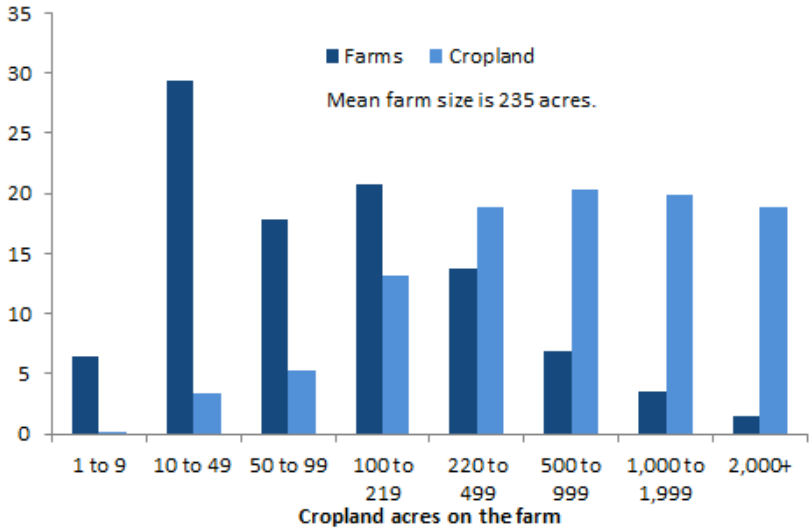
Concealed within the summary U.S. and state data are two more complex trends illustrated in Figure 1-0-7. First, mid-sized and large farms have grown much larger, particularly grain operations. USDA reports that most cropland (53.7 percent) occurs on farms with at least 1,000 acres (the two highest intervals in Figure 1-0-7), and notes that "many farms are 5 to 10 times that size."[14]

Meanwhile, the remaining small farms have gotten much smaller. The largest percentage of U.S. farms

with cropland is concentrated on those with 10 to 49 acres (second smallest interval), but the largest percentage of cropland (34.3 percent) occurs on farms greater than 2,000 acres (the largest interval). As noted in Figure 1.0-7, the mean size of farms with cropland in the U.S. is 234 acres.

It is interesting to note that the mean size of Maryland's farm with cropland in 2012 was 235 acres (see Figure 1-0-8), which is nearly identical to the nation as a whole. However, the bulk of cropland in Maryland is concentrated on midsized farms between 100 to 1,000 acres, with proportionally less occurring on farms in the largest intervals compared to the nation as a whole (Figure 1-0-8). Maryland has a smaller percentage of very large farms.

Figure 1.0-8: Percent of farms or acres in Maryland 2012



A second USDA report examines the significance of farm size. According to *Structure and Finances of U.S. Farms: Family Farm Report, 2014 Edition*, "midsize and large-scale farms account for 8 percent of U.S. farms but 60 percent of the value of production."[15] On the other hand, the report notes that "Extensive economies of scale do not exist in farming. Most cost reductions can be attained at a relatively small business size, compared with other industries, even though farming tends to be capital intensive in the United States."[16]

According to this report, profitability appears to be related to "farm type" according to principal work status of the operator. Farms where the principal income of the owner is from non-farm employment (off-farm occupation farms) are the least profitable, with 25.2 percent reporting positive operating incomes. "Retirement farms" reported 37 percent positive incomes.

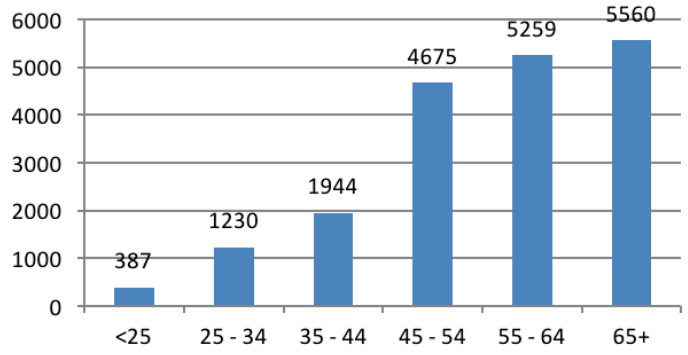
The report also notes that government payments and federal crop insurance have been heavily utilized by some U.S. farms, particularly midsize and large ones. In Maryland, 4,628 farmers (37 percent) reported in the 2012 Census of Agriculture that they received on average $7,784 in government payments. The 2014 Farm Bill has changed the types of government assistance to farmers and should broaden the use of crop insurance. However, it is too soon to document the changes.

As the size of farms has been increasing and the number of farms decreasing, we have seen changes in farm type, in the average age of farm operators and in the primary occupation of many farmers. In the U.S., 42 percent of all farms are designated as "off-farm occupation farms" and another 16 percent are "retirement" farms. In Maryland, 51 percent of all principal farm operators indicated that their primary occupation was off-farm, and most off-farm income farms are the smaller farms.

The low profitability of smaller farms may have impacted the attractiveness of farming as an occupation for younger generations. As indicated by the 2012 Census of Agriculture, the types of farms that have maintained or increased market share are poultry and grain. These industries require either high capital costs or high infrastructure costs, or both.

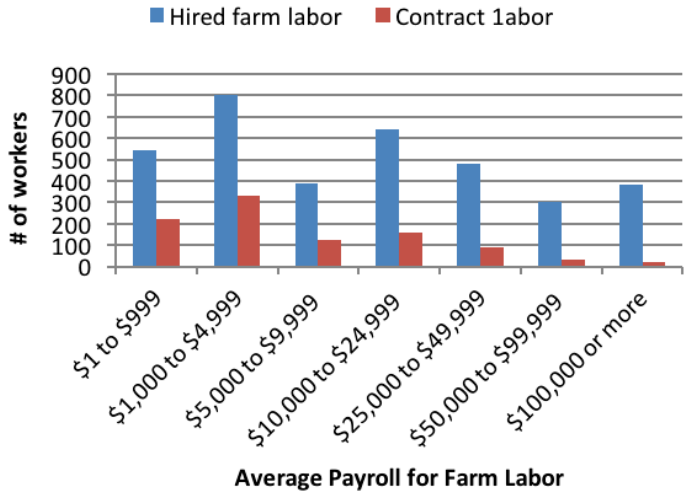
Again, following national trends, the number of young farmers has been declining in Maryland. From 1978 to 2012, the number of Maryland farmers under age 35 has decreased by 70 percent.

Figure 1.0-9: All Maryland Farm Operators by Age Group 2012 Ag Census



In 1920 there were roughly the same number of farm operators 65+ in Maryland as there are farm operators in that age category today. However, there were 4,081 farm operators under 35 in Maryland in 1920 versus 1,617 farm operators under 35 in 2012, or 5 percent of all farm operators. This raises an important question: who will replace our older farmers when they retire?

Figure 1.0-10: Maryland Farm Labor and Contract Labor in 20112 – US Ag Census, Number of Farm Workers by Payroll



Labor

Maryland farm labor needs appear to be modest. The estimated employment in the farming, fishing and forestry trades combined totaled 5,742 in 2012 and was projected to grow to 5,923 in 2014, according to the *State of Maryland Agricultural Outreach Plan*, dated April 18, 2014. "The majority of agricultural labor in Maryland is accomplished by family members on family-run farms. Those migrant and seasonal farm worker individuals working in the agricultural labor pool admit overwhelmingly to having an undocumented status and therefore are ineligible for services by statute, thus explaining why Maryland's reporting numbers for use of workforce services have declined."[17]

The report notes that the major crop activities needing migrant and seasonal farm workers are nursery stock, vegetable farms and fruit orchards. Farmers hire approximately 1,200 workers from March to November.

According to the 2012 Census of Agriculture, 29 percent of Maryland's 12,256 farms (3,536) report having hired farm labor, and a total of 979 farms (8 percent) reported hiring contract labor. Only 384 farms (3 percent) spend more than $100,000 on farm labor and only 21 farms spend more than $100,000 on contract labor.

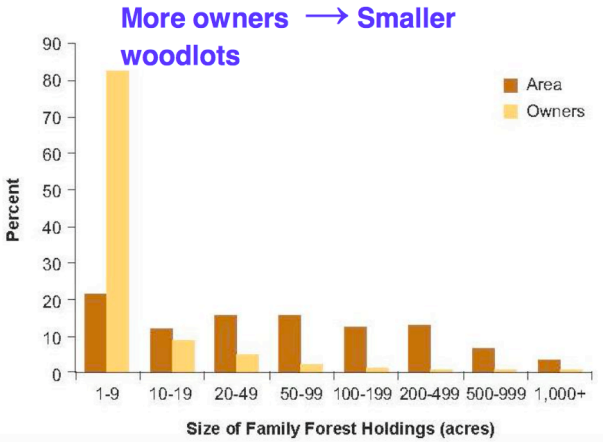
Forestry

Property size is also of interest with respect to forestland. A large percentage of Maryland's forest is held in small woodlots, making it more financially difficult to warrant a timber harvest. In addition, esthetics, privacy and other factors come into play when deciding whether or not to sell timber.

An ongoing concern of the industry will be the future division of forest land into smaller tracts. Timber harvests require permits, preparation of entrances, and the movement of large equipment. The smaller the tract, the less feasible timber harvesting is. Figure 1-0-11 highlights the situation.

The fragmentation and "parcelization" of forest lands introduces a cultural shift, as well. Instead of seeing forestland as a sustainable, income-producing resource base, owners of small forested parcels view them as part of their extended homestead and as their recreational areas. Urban cultural values replace rural. In addition to not doing forest management on their own

Figure 1.0-11: Steven Koehn, The Industry of Maryland's Forests, Size of Family Forest Holdings



property, often these residents frown on timber management in the neighborhood in most forms, including thinning, harvesting and other practices like prescribed burns and aerial spraying. Where these urban attitudes become dominant, other forest owners are discouraged from sustainable timber management on their land and become more likely to sell it for development or other uses.

All of these factors have a cascading effect on the local timber market. As available timber supplies are reduced and harvesting becomes costlier, local mills may find themselves squeezed out of the market. When a mill closes, as many in Maryland have in recent years, jobs are lost and contractors such as logging and trucking companies are forced to reduce size, move or stop operating. That shrinks buyer competition for the remaining forest landowners, creating more incentive to abandon commercial forestry and take advantage of real estate markets. Since virtually all timber must be processed within 50-100 miles of where it is grown, these local markets are an essential key to the future of sustainable forestry in Maryland.

1.4 The Impact of Climate Change

Agriculture has always been influenced by soil quality, availability of the latest modes of transportation, consumer trends and preferences; and of course it has always been influenced by storms, rainfall totals and other climatic conditions. As far back as the nineteenth century, scientists began to raise concerns about the emission of greenhouse gases. Then, in 2007, the Intergovernmental Panel on Climate Change (IPCC) concluded that the "warming of the climate system was unequivocal."

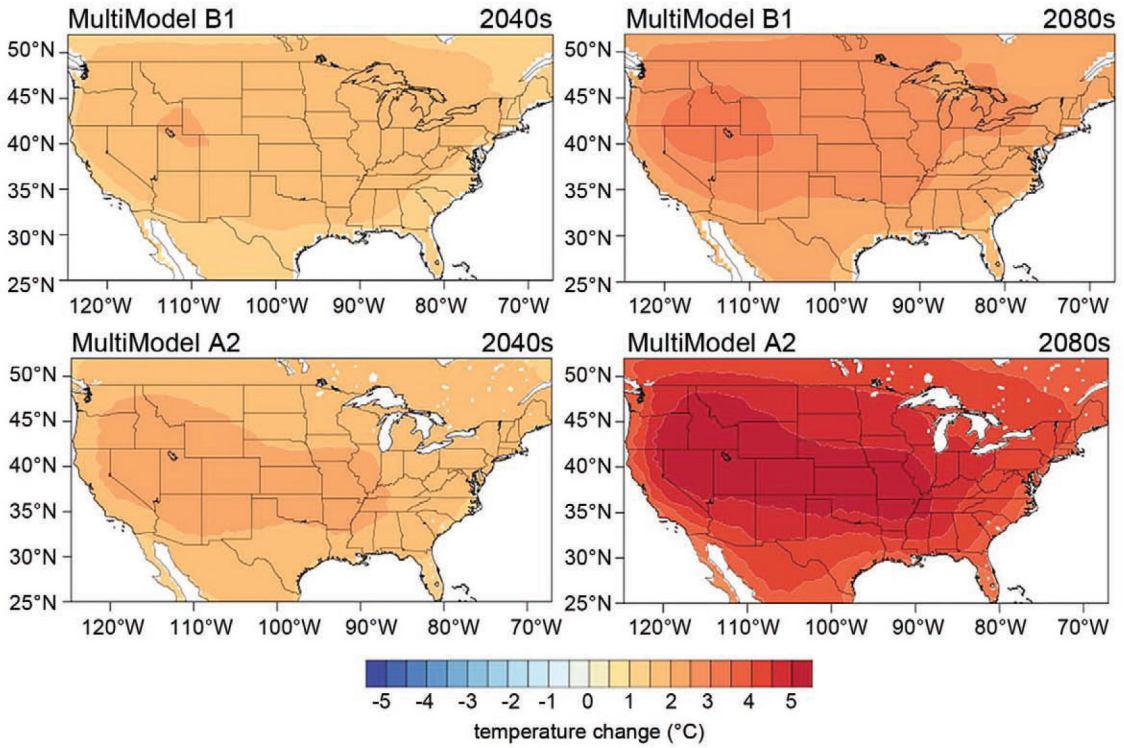
In 2013, the United State Department of Agriculture released its report, *Climate Change and Agriculture in the United States: Effects and Adaptation.* In Chapter 1 it notes that "U.S. agriculture is a multi-billion-dollar industry that stands to be significantly influenced by the effects of climate change."[18] The report highlights U.S. agriculture's vulnerabilities due to rising temperatures and changes in weather patterns and quantities of rain. It also suggests adaptation strategies for governments and farmers. The focus is on the next 25 years because the "climate projections are relatively more certain and address more immediate planning and management needs."

Major Climate Trends

- Long-term temperature records demonstrate that every decade in the late twentieth century has been warmer than the preceding decade. Based on a high emissions scenario, global temperatures would increase by between 0 and 5.4 degrees C by 2100.
- Ocean temperatures have increased and sea level is rising about 3.4 millimeters per year. Recent studies suggest a much more rapid rate of increase in the current century due to the melting and collapse of the Antarctic and Greenland ice sheets.
- Precipitation is highly variable, and rainfall events have intensified. Larger rainfall events are producing a higher percentage of all rainfall.
- Mountain glaciers and ice caps are receding, which reduces flow into rivers and lakes and the amount of water available for agriculture.

There are challenges to predicting how climate trends will impact specific regions and weather patterns. However, the results from the temperature increases that have already occurred provide scientists with some clues to future

Figure 1.0-12: USDA Climate Change Report — Projected Temperature Changes in the Summer



trends. The report notes that Alaska has warmed the most, followed by the northern Midwest and Southwest. Rainfall totals are more difficult to predict. As per past trends, "Much of the Northwest, Central, and Southern United States now receive more precipitation than 100 years ago, while other areas, such as parts of the Eastern Seaboard and the Rocky Mountains and much of the Southwest, receive less."[19]

Climate projections for the twenty-first century are based on four models ranging from low to high emissions. The report predicts that the entire United States is likely to warm substantially over the next 40 years, with an increase of 1°C to 2°C over much of the country, a greater rate than the last century. The increases are not expected to be uniform. The interior United States is likely to see average increases of 2°C to 3°C, while the southeastern and western coastal areas are expected to warm by 1°C to 2°C degrees. In 2008, the Maryland Commission on Climate Change predicted that average temperatures will increase by 3°F by mid-century and could increase by as much as 9°F by the end of the century if greenhouse gas emissions continue unchecked.[20]

Farmers, agronomists and climatologists are well aware of the impact that climate change has had and may have on agriculture and forestry. They have already seen changes in the crops that can be grown in Maryland and have noticed changes in flora and fauna. All plants have minimum, maximum and optimum temperatures. When temperatures exceed those ranges, then plant growth and pollination are affected. In the USDA Plant Hardiness Zone Map published in 2012, zone boundaries shifted north from the previous map. As a result of climate change, some crops currently planted are less productive in Maryland, while other crops, commonly produced further south, have become viable in the state.

All four USDA models show the Mid-Atlantic region getting more rainfall as the climate warms, as much of the Midwest and West is predicted to be drier. While Maryland is predicted to get more rainfall, state farmers and residents may need every drop. According to the Wolman Report

published in 2008, Maryland's population will grow from 5.3 million in 2000 to 6.7 million in 2030. In 2007, approximately 92,805 acres of cropland were irrigated. By 2012, there were 104,910 irrigated acres. In addition, "climate change has the potential to affect both water quantity and quality through changed patterns of precipitation, increased evaporation, sea level rise that causes salt-water intrusion, and warmer temperatures that cause increased demands for drinking water, irrigation and power production."[21]

The impact of climate change on farming may vary over time. In the short term, higher carbon dioxide emissions may be of benefit to a number of crops, and a longer growing season could also increase total production. However, as temperatures continue to increase, traditional crops will experience heat stress and face longer droughts. Livestock production would also be compromised by heat stress.

Climate change is an increasingly recognized risk for sustainable forestry. In commercial management, forests are grown in rotations that last from 25 to over 100 years. In Maryland, softwoods are commonly grown in 35-50 year rotations and hardwood rotations may be 100-150 years in length.

While most tree species are resilient to modest changes in heat and moisture, all are adapted to a certain range of conditions. When conditions begin to go outside that range, smaller, more mobile members of the ecosystem are the first to respond. For example, migration of more southerly temperature regimes to the north will move bird species north. Their predation on insect populations may be reduced in former habitats, and insect damage to plants, including trees, increased. Where winter temperatures are higher, or freeze periods shorter, some insects may survive overwinter at higher rates, or produce more generations in a single summer. All of these changes are reflected in the ecosystem, and present production challenges for forestry professionals.

Maryland's Atlantic Coastal Plain contains the approximate current boundary between the southern pine region and the northern hardwood region. Loblolly pine is common on the Lower Eastern Shore, but hardwoods predominate on the Upper Shore. That boundary, according to Forest Service projections, will move significantly northward in the coming decades. Likewise, the maple-beech-birch forest of Western Maryland is likely to be replaced with pine trees. Landowners at the boundary will be challenged to plant or favor species that will prosper in the next 50 years, often without good information about how, and how rapidly, those environmental changes will occur. This presents a major research challenge to climate and forest modelers, as well as educational institutions.

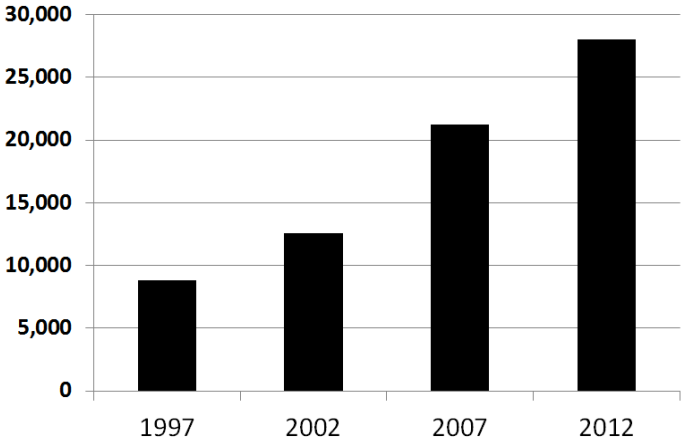
1.5 Emerging Trends in Agriculture and Forestry

In Table 1-5, we listed the top agricultural products sold in Maryland, according to the 2012 Census of Agriculture. Some of the top products have been in a long decline, some have been emerging or growing, and some may have experienced a temporary decline due to weather, market conditions or the state of the economy. For example, both the nursery and equine industry (especially race horses) were hit by the Great Recession. Both are discretionary purchases more impacted by the economy than food items. A few emerging trends may prove to have a significant impact on Maryland agriculture over time. They include the local food movement, organic farming and aquaculture.

Local Food Movement

Over a century ago, nearly all food was local. For the food to be consumed fresh, it had to come from nearby farms. According to a USDA report, "Growing interest in local foods in the United States is the result of several movements. The environmental movement encourages people to consider geographic dimensions in their food choices. Long-distance transport of food is considered to contribute to greenhouse

FIGURE 1.0-13: US Census Of Agriculture, Maryland Direct Sales of Farm Products Sold ($1,000)



gas emissions. The community food-security movement seeks to enhance access to safe, healthy, and culturally appropriate food for all consumers. Challenges to the dominance of large corporations have also contributed to efforts to expand local food. The Slow Food movement, which originated in Italy, is a response to homogenous, mass-produced food production, and the 'fast' nature of people's lives, by encouraging traditional ways of growing, producing and preparing food."[22] However, in recent surveys, a major motivation is to help local farmers and the economy. A survey by A.T Kearney entitled *Buying into the Local Food Movement* indicated that people also trust the local farmer more than other sources.

As demand for local food has been growing more than 25 years, it appears to be more than a fad. In a January 2015 report to Congress, the USDA noted that the number of farmers markets in the U.S. grew by 180 percent since 2007, while the number of food hubs has increased by 288 percent, and the number of farm to school programs has increased by 430 percent.[23]

In Maryland, direct sales to consumers for human consumption rose 32 percent from 2007 to 2012 through farmers markets, roadside stands, community supported agriculture, etc., according to the 2012 Census of Agriculture. To date the census does not collect data about indirect sales through local aggregators.

Included in the local food movement are beverages. The winery industry has grown steadily, with particular gains in Southern Maryland and on the Eastern Shore. The industry estimates that sales rose to $26 million in 2013. Wineries also benefit the tourism industry. Local brewery sales are gaining a foothold in the beverage industry too, with 35 Maryland breweries operating in 2015, according to the Maryland Brewery Association.

Finally, the local food movement has benefitted the livestock industry. An increasing number of cattle, pigs, goats, sheep and chickens are being processed and returned to the farm to be marketed online, from the farm and at farmers markets. Local meats are showing up in some Community Supported Agriculture (CSA) bags, too. Unfortunately, these statistics are not being collected yet in the Census of Agriculture.

Maryland has made progress in local sales, but still lags behind many states. For example, according to the 2012 Census of Agriculture, per capita direct sales in Vermont were $44; Maine, $19; and New Hampshire, $15. Maryland's direct sales were roughly in the middle of all states at $6.* Clearly ahead, Vermont has worked hard to increase sales. The state adopted a Farm to Plate Plan and is proactive in its implementation. According to their Case Study Report, the Vermont Farm to Plate Network added 3,486 direct jobs and 645 food businesses from 2009 to 2014, with an increase of $747.1 million in gross state product.

One way that farmers have been able to increase access to consumers is through food hubs. The USDA has recognized five food hubs in Maryland, and a 2014 report[24] from the Southern Maryland Agricultural Development Commission identified another four emerging food hubs. The report uses the following definition of food hub: "a business or organization that actively manages the aggregation, distribution and marketing of source-identified food products, primarily from local and regional producers to strengthen their ability to satisfy wholesale, retail and institutional demand." Through food hub aggregation and distribution

* USDA Census of Agriculture 2012.

systems, local farmers can market to institutions, restaurants and retail stores where sufficient supply is critical.

Beyond food hubs, there has been a movement toward foodshed networks, such as the recently formed Chesapeake Foodshed Network, which has begun organizing to garner support for a food system that supports the local economy, the environment and society.

Organic Production

As per the 2012 Census of Agriculture, the organic movement is well established in the U.S., with total sales growing at a double digit rate each year. Maryland was late on the scene in organic production. However, between 2007 and 2012, the value of sales increased 118 percent.

The top states for organic sales include California, Oregon, New Mexico and New York. Most beginning farmers indicate that they prefer to grow organically. However, the complex USDA certification process steers many away. The Maryland Department of Agriculture assists in the process and may have contributed to the recent increase. The Perdue Company's entrance into the organic chicken market is likely to increase interest in growing organic grain in the state.

Aquaculture

Virginia was the first Chesapeake Bay state to promote river bottom leases for oyster production. Those efforts have been very successful, with 100,000 acres under lease. In 2009, Maryland adopted a law legalizing oyster aquaculture and requiring oyster lease-holders to work the leases they had or lose them. According to Karl Roescher, Manager & Aquaculture Coordinator of the Maryland Department of Natural Resources, as of February, 2015, Maryland had 319 shellfish aquaculture leases on nearly 4,000 acres. Another 100 applications were in process. Maryland also has low interest loan programs from the Maryland Agricultural and Resource-Based Industry Development Corporation (MARBIDCO) and training programs for beginners.

Figure 1.0-14: US Census of Agriculture, Value of Sales of Certified or Exempt Organically Produced Commodities in Maryland ($1,000)

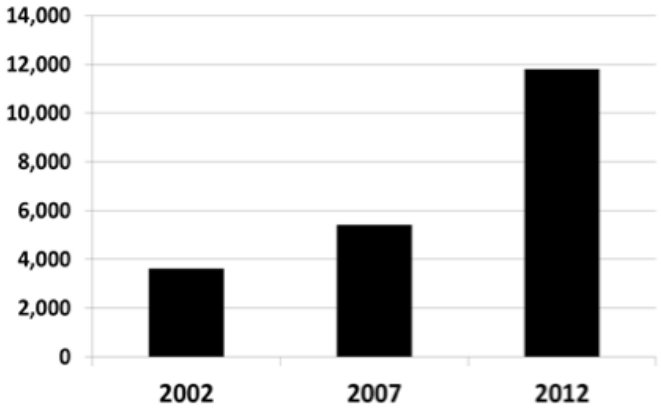
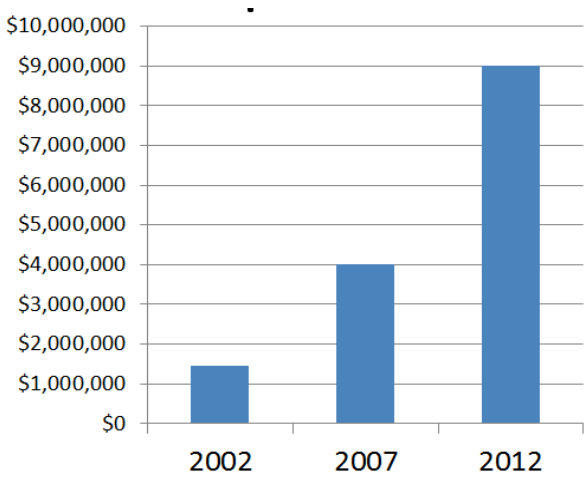
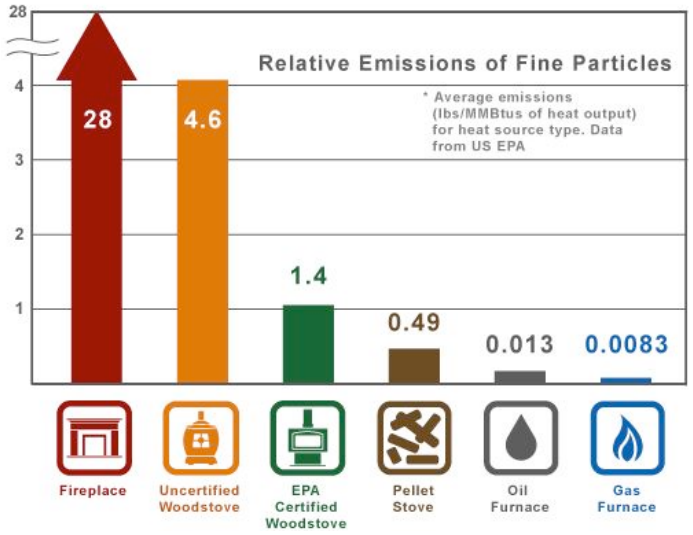


Figure 1.0-15: US Census of Agriculture, Maryland Aquaculture Sales



Maryland aquaculture sales have grown rapidly in the last decade, 125 percent between 2007 and 2012, to become the 11th highest agricultural sales product in the state, according to the 2012 Census of Agriculture. River bottom leasing is occurring at a time when the Bay is in recovery, and may in fact be part of its recovery. National and international studies have shown the oysters grown on the river bottom can reduce nitrogen and phosphorus in the water.

Figure 1.0-16: EPA Report, Relative Emissions of Fine Particles by Energy Source



1.6 Improved Technologies and Efficiencies

Improved fertilization, genetics and technology have revolutionized agriculture in the U.S. Better Extension training, better equipment, more specialization, improved plant genetics, and more effective herbicides and pesticides have all played a role in the increases in yield.

Today, farm equipment guidance systems and global positioning mapping are in vogue in "precision Ag" commodity crop farming. Global Positioning System (GPS) software allows farmers to apply variable planting and fertilization rates based on soils. These systems are also being used for records and insurance purposes.

Drones will be the next big technology. Drones will have the capacity to monitor crops for a wide variety of crop production essentials, such as nutrient levels, soil moisture and pest pressure.

In the forestry industry, new technologies have significantly changed timber harvesting methods as hand labor has been replaced by machines. Timber harvesting on slopes of 25-30 percent or less is largely done by mechanized feller-bunchers that cut and pile trees for skidding to the landing by large wheeled skidders. The impact on the remaining forest reproduction and standing timber, as well as soil and water resources, is minimized, while the merchandizing of suitable timber is facilitated. The safety risks formerly associated with chain saw felling and bucking, as well as setting chokers for tractor or cable skidding, have been reduced. The advent of high-flotation machines has reduced soil compaction and rutting, allowing operations to proceed with less impact on soil and water quality.

New technologies have also greatly increased the efficiency of wood as a heating source while reducing air pollution from burning wood.

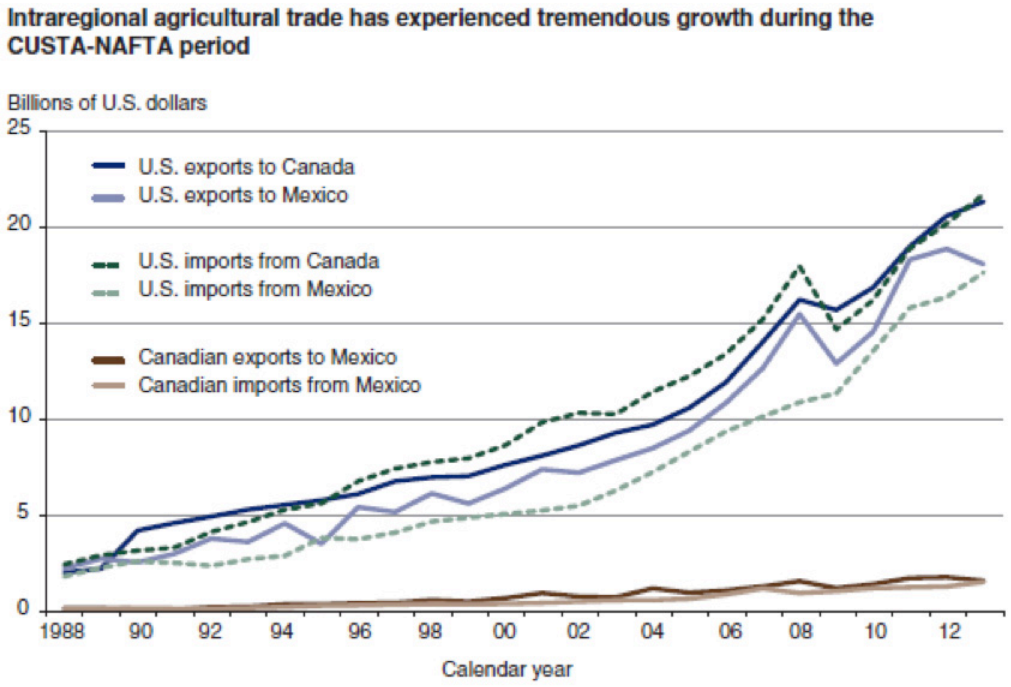
Wood is a renewable resource. Using wood as a heat source creates jobs and can also be a means to fully utilize tree tops, laps, and limbs in logging operations. Wood is an effective heat source on cold winter nights when other green energy sources such as solar and geothermal systems are much less effective. According to U.S. Census data, the use of wood heat in Maryland grew by 33 percent from 2000 to 2010. Much of that increase occurred when there were increased prices for oil and propane. Energy prices dropped in 2014 and 2015. Continued growth in wood heat sources will depend on competitive pricing.

1.7 Global Markets

According to the Maryland Trade Promotional Authority,[25] "Maryland's agricultural exports reached an estimated $760 million in 2012, up from $530 million in 2008. Maryland's exports help boost farm prices and income, while supporting about 5,000 jobs both on the farm and in related industries such as food processing, transportation and manufacturing. Export sales accounted for approximately 33 percent of total Maryland farm receipts in 2012."

The report notes that Maryland's top five agricultural exports in 2012 were soybeans ($163 million), broiler meat ($149 million), wheat ($55 million), corn ($39 million) and soybean meal ($33 million). Principal buyers were from South America.

Figure 1.0-17: USDA, Growth in Imports and Exports as a Result of CUSTA-NAFTA



CUSTA= Canada-U.S. Free Trade Agreement. NAFTA = North American Free Trade Agreement.
Source: USDA, Economic Research Service, using U.S. trade data from U.S. Department of Commerce, Bureau of the Census, *Foreign Trade Statistics*, as presented by USDA/FAS (2014a), and Canadian trade data (for Canada-Mexico trade) from Statistics Canada, CATSNET Analytics (2014).

Nationwide, U.S. food and agricultural exports reached a record $140.9 billion in fiscal 2013. Global demand for these products is growing, but competition among suppliers has been growing, too. Imports have been rising more quickly as well.

The North American Free Trade Agreement (NAFTA) was implemented 20 years ago. The USDA released a report[26] in February 2015 that noted a brisk trade in agricultural products.

Maryland is a small player in overall U.S. trade but the impact on Maryland Agriculture is significant. Maryland's agricultural exports reached $808 million in 2013.* According to the report, the top exported products are poultry, eggs and grain.

1.8 Summary

Maryland has soils, climate and rainfall well suited to support agricultural and forestry production. Its densely populated centers provide market opportunities.

Transportation via water was a major asset in the eighteenth and early nineteenth centuries. Over time, rail became a preferred method of transportation, which opened up the vast rich farmland in the Midwest. Then irrigation systems and year-round farm production in California in the early twentieth century moved the center of agriculture to the West Coast, and the interstate highway system, starting in the 1950s, further weakened Maryland's transportation advantages and proximity to markets.

The trend toward more specialized and larger operations in the U.S. over the last century has not been a friend to agriculture in the East Coast states, including Maryland. However, poultry production has become a powerful niche for the Delmarva region and commodity farmers have benefitted from the strong economic boost.

* USDA Agricultural Foreign Service, Trade Promotion Authority, *What's at Stake for Maryland Agriculture?,* March, 2015.

Emerging markets give promise of a more diversified farming future.

The forestry picture is bleaker. Production and local markets have continued to slide despite the increase in marketable timber. The movement of logs is difficult along clogged urban highways, and rail and water are not viable transportation options. Until some successful negotiations by the Department of Forestry in 2015, state policy has stymied the green building movement's use of Maryland lumber. Barriers still exist for the use of wood as a heating source.

Climate change could turn the tables once again if higher temperatures and drought continue to compromise agricultural production and dry up rivers and aquifers in the West. Maryland farmers will not escape from the impacts of climate change either. Drought/flood cycles are projected to be more profound and heavy rain events are projected to be more common, exacerbating existing erosion control challenges.

Smart growth regulations have been enacted to reduce sprawl and concentrate development in designated growth areas. Environmental regulations have been adopted to protect the Chesapeake Bay and environmental resources. In the next chapter, we discuss the effectiveness and impacts of the new regulations in relation to the sustainability of agriculture and forestry in Maryland. In Chapter 3, we assess the implications of smart growth policies and practice.

Chapter 2: Implications of Environmental Regulations

2.1 Nutrient Management Regulations and the Phosphorus Management Tool

2.1.1 Background

Protecting "the commons," or resources that are held in common, is a concept that dates back centuries. In eighteenth century England, the commons were lands around villages on which residents could graze their livestock. Problems arose when the pastures could no longer accommodate the number of animals, and the fodder, animals and people all suffered. As world population has increased, the issue of managing the commons has extended to other goods like air and water, the degradation of which affects the general public.

Dr. Walter Boynton, professor at the University of Maryland Center for Environmental Science (UMCES) Chesapeake Biological Laboratory, has often commented that nitrogen and phosphorus are essential nutrients for plant life (all life, in fact). However, when they exceed certain levels in waterways, they become pollutants, stimulating excessive growth of algae that deprive other aquatic plants and animals of oxygen and sunlight. Boynton estimates that such levels reached the tipping point in the Chesapeake Bay around 1960.

The source of many smart growth and environmental regulations in Maryland can be traced to Chesapeake Bay cleanup efforts that date back to the 1970s. Though the economic and esthetic advantages of a healthy Bay are not the subject of this paper, their importance is a factor in land use and economic decisions. A recent report estimates that cleanup of the Bay would result in $22 billion in added annual economic value throughout the watershed. Without the cleanup, it projects that the value of these natural benefits of a healthy Bay would decline by $5.6 billion annually.[27]

2.1.2 Chesapeake Bay Agreements and Nutrient Management

In 1978, a Maryland-Virginia Chesapeake Bay Advisory Commission was convened to evaluate Bay resource management programs. It recommended the formation of a bi-state commission, which eventually became the Chesapeake Bay Commission.

The Chesapeake Bay Commission played a leadership role in preparing the Chesapeake Bay Agreement of 1983, signed by the governors of Virginia, Maryland and Pennsylvania, the mayor of the District of Columbia, the administrator of the U.S. Environmental Protection Agency and the chair of the Chesapeake Bay Commission. The agreement begins with these words: "We recognize that the findings of the Chesapeake Bay Program have shown an historical decline in the living resources of the Chesapeake Bay...." According to the agreement, the executive council will meet "at least twice yearly to assess and oversee the implementation of coordinated plans to improve and protect the water quality and living resources of the Chesapeake Bay estuarine system."

That agreement was followed by a more expansive 1987 Chesapeake Bay Agreement. It acknowledged the jurisdictions' share in responsibility for the Bay's current condition and outlined goals and priority commitments to restore and protect "the living resources, their habitats and ecological relationships."[28] The 1987 Bay agreement set goals to occur by 2000.

Eight goals and related statements of commitment are included in the 1987 Agreement. The second goal reads as follows: "Reduce and control point and non-point sources of pollution to attain the water quality condition necessary to support the living resources of the Bay." To achieve this goal, the organizations represented agreed (among other actions) to develop and begin implementing

by July, 1988 a plan to reduce nitrogen and phosphorus by 40 percent from 1985 levels. This became a basis for the adoption of Maryland's Nutrient Management Requirements.

A third goal of the 1987 Chesapeake Bay Agreement states, "Plan for and manage the adverse environmental effects of human population growth and land development in the Chesapeake Bay Watershed." To achieve this goal, a panel of experts was commissioned in the 1990s to report on anticipated population growth and land development patterns and to prepare development policies and guidelines to reduce adverse impacts on water quality and living resources. This report became a basis for the adoption of Maryland's smart growth legislation.

No specific measures were established to manage the adverse environmental effects of human population and land development as part of the 40 percent nutrient reduction plans. There was progress toward many of the goals of the 1987 Agreement, but—judging by the need for subsequent agreements and the TMDL—few have been achieved.

In 1997, Maryland was pushed to act sooner rather than later when a Pfiesteria outbreak[29] occurred on the Eastern Shore and was attributed to excessive nutrients from poultry operations. As a result, Maryland adopted the Water Quality Improvement Act (WQIA) of 1998. It included a requirement that agricultural producers of a certain size prepare and follow nutrient management plans for both nitrogen and phosphorus when fertilizing crops and managing animal manure. (A voluntary nutrient management program had been in place since 1989 based on nitrogen recommendations only.) The law also required development of a Phosphorus Site Index (PSI) to determine the amount of phosphorus that a producer could use on a given field. The PSI applied only to fields with a phosphorus field value of 150 or more. Farmers grossing less than $2,500 a year and livestock producers with less than 8,000 pounds of live animal weight were exempt.

The nutrient management plans had to specify how much fertilizer, manure or other nutrient sources could be safely applied to crops to achieve yields while preventing excess nutrients from polluting waterways. MDA's compliance section required that nutrient management plans follow University of Maryland application rates. Violators could be subject to fines and penalties of up to $2,000 a year and loss of MDA cost-share grants. MDA oversaw a training, certification and licensing program for nutrient management consultants and farmers.

Nutrient management planning can be an effective tool for cleaning up the Bay, but the restoration will never succeed without similar efforts in all the Bay jurisdictions. Virginia, Pennsylvania and Delaware adopted nutrient regulations after Maryland did, but Virginia's apply only to poultry operations, Pennsylvania's apply only to concentrated animal operations, and Delaware's are voluntary.[30]

A third Chesapeake Bay Agreement was signed in 2000. It acknowledged that despite significant accomplishments, even greater effort was needed. This plan implemented tributary strategies and EPA agreed to give states until 2010 before imposing TMDL requirements This agreement included more measurable objectives, such as:

- A tenfold increase in native oysters by 2010,
- Restoring fish passage for migratory fish to more than 1,357 miles of currently blocked river habitat by 2003,
- Restoring 25,000 acres of tidal and non-tidal wetlands by 2010,
- Establishing 2,010 miles of riparian forest buffer by 2010, and
- Correcting the nutrient- and sediment-related problems (the 40 percent reductions agreed to in 1987) by 2010 "to remove the Bay and the tidal portions of its tributaries from the list of impaired waters under the Clean Water Act."[31]

Again, progress was made in subsequent years, especially on specific projects where jurisdictions could work with partners and landowners to achieve a goal, such as funding of oyster seed,

restoring fish passage, planting trees and restoring wetlands. However, non-point pollution remained as the greatest challenge to overcome through voluntary means.

2.1.3 EPA Establishes Total Maximum Daily Load

As of 2009, it was clear that the actions to achieve the nutrient- and sediment-related reductions would not be accomplished in the foreseeable future, so the Chesapeake Bay Foundation and its partners filed suit against the United States Environmental Protection Agency (EPA) for failure to enforce the Clean Water Act.

On May 10, 2010, a settlement agreement[32] was signed, requiring the EPA to establish the Bay Total Maximum Daily Load (TMDL) prior to December 31, 2010 and to take appropriate action to ensure that the Bay jurisdictions (including portions of West Virginia, New York and Delaware) do the following:

- Develop and implement adequate Watershed Implementation Plans and two-year milestones related to nutrients and sediment,
- Demonstrate satisfactory progress toward achieving nutrient and sediment allocations,
- Achieve their two-year milestones, and
- Issue National Pollutant Discharge Elimination System (NPDES) permits consistent with the Bay TMDL's waste load allocations.

On December 29, 2010, the EPA established a TMDL, or "pollution diet," for the Chesapeake Bay. It set goals for each state and the District of Columbia to achieve by 2025, with 60 percent of the reduction to be achieved by 2017. In August 2011, the EPA provided revised nutrient and sediment target loads to the Bay jurisdictions based on an updated Bay model.

2.1.4 Maryland's Efforts to Comply with EPA Mandate

In Maryland, nutrient and sediment load allocations were assigned to major Maryland river basins. It was up to the state to assign load reductions by county and source sector. An agriculture plan for nutrient reductions was prepared with the assistance of Maryland Department of Agriculture and Soil Conservation Districts.

Maryland appeared eager to take the lead in the Bay cleanup and initially promulgated an even more aggressive cleanup timing strategy than required by the EPA. Under Governor O'Malley, the state began to upgrade sewer treatment plants, increased stream buffer plantings, financed cover crop planting programs, imposed tougher restrictions on residential development on septic systems, and pressed counties to adopt non-point pollution reduction strategies in their Watershed Implementation Plans. The hope was to achieve EPA milestones ahead of schedule.

2.1.5 Impacts from the Nutrient Management Regulations[33] (1989-2012)

NUTRIENT MANAGEMENT PLANS

A nutrient plan for a whole farm is a surprisingly complex document that accounts for the management history of the field; previous yields; the underlying soil profiles; regular soil tests; estimates of nutrient contributions from previous leguminous crops; organic fertilizers and methods of their application; and the nutrient needs of previous, current and future crops based on the crop rotation. Most farmers use different varieties of seeds bred with different requirements. When one considers that all these variables must be accounted for on multiple fields and often on multiple farms for individual operations, it is little wonder that the plans can run into hundreds of pages. The plans must be written by a certified planner.

According to Maryland Department of Agriculture's Nutrient Management Program 2014 Annual Report, 98.6 percent of Maryland farmers had nutrient management plans. Farmers are also required to submit Annual Implementation Reports, and 97.9 percent complied. Those who submitted late or failed to submit Annual Implementation Reports

"Nutrient management is good and important. Having it become mandatory didn't cause farmers to go out of business."

— Luke Howard

"I saw no evidence of people going out of business around here (Eastern Shore). Compared to crop and milk prices it was nothing."

— Ken Staver

"It did not make or break farmers' operations."

— Buddy Hance

were audited and fines were imposed for late, inaccurate or inconsistent reports. According to the report, the state issued $3,850 in fines to 11 farmers for failure to file nutrient management plans, $23,250 in fines against 93 farmers for late or missing annual implementation reports, and $21,450 in fines against 33 farmers who failed to take corrective actions in a timely manner. The department also conducts nutrient management audits in the field to assure compliance. In 2014, 14 percent of regulated farms were audited. In addition to nutrient management, the regulations have additional requirements that can cost time and money. Fertilization setbacks of from 10 to 35 feet from streams (depending on the form of application) can reduce the land available for farming. Incorporating all organic fertilizer within 24 hours requires significant labor and machinery at an extremely busy time in the agricultural cycle. Restrictions on the use of organic fertilizer during the winter can affect the establishment of winter crops and require expanded storage capacity, an extremely expensive proposition depending on the farm.

No farmer wants to spend more money on nutrients than needed to grow a successful crop. However, it is also true that a farmer always wants to give the crop the best chance of achieving as high a yield as possible in a given year, and effective nutrient management can increase efficiency and net profits. According to a study that focused on plans prepared pre-1998, when they were voluntary, farmers who prepare nutrient management plans themselves (rather than relying on outside parties to prepare them) are less likely to recommend higher fertilizer rates.[34]

Another factor in crop growth that complicates nutrient management is the timing and amount of rainfall. Without irrigation, the farmer has no control. Will this be the perfect rain year in which corn grows a bumper crop and uses up all available nitrogen? Or will this be a year when the rain shuts down after fertilizer was applied, leaving much of it in the ground and susceptible to run-off later? In the latter case, best management practices (BMPs) such as cover crops and stream buffers help trap excess nutrients. But if the farmer fails to provide sufficient plant food up front, he or she may lose out on a significant economic opportunity. These are business decisions that farmers must face on a regular basis: balancing input costs, potential profit, stewardship and regulation.

The impact of these regulations on farmers (as with all new regulations) varies by type of production, farm size, location and type of nutrients. Very small operations are less affected because the volumes of nitrogen and phosphorus are less. Mid-sized farms can face a more difficult burden if their cash flow is affected by the increased costs of obtaining plans or investing in equipment needed to implement them. Many grain farmers had grown accustomed to managing nutrients (particularly nitrogen) more closely, in part to be efficient and profitable—especially when fertilizer prices spiked—when the program was voluntary. Those not using manure were not severely impacted economically by the mandatory regulations passed after the Pfiesteria crisis. In fact, the consensus from our industry interviews (see quotes in text boxes on the following pages) is that the negative impacts of changes in nutrient management—restricting the amounts of nitrogen and phosphorus that could be used, investments in planning and the associated paperwork and intrusion into farmers' autonomy of decision

making—did not cause major disruptions for grain or livestock producers or directly cause many farms to go out of business.

Increases in time, cost and reporting certainly had some economic impact and undoubtedly engendered general resentment. Farmers express frustration when they are required to develop complex written plans that don't substantially change their management. They also resent having to follow a standardized schedule of dates that allow or prohibit practice implementation rather than base decisions on their own experience and actual conditions on their farm.

> *"Farmers don't like having to do something at certain time. The want the ability to make the call when they want."*
>
> *— Sean Clougherty*

> *"I heard farmers say that following regulations and the plan didn't change what they were doing, (it was just) more paper work. Didn't affect profitably, it was just 'a pain'."*
>
> *— Ken Staver*

Such factors, causing frustration more than financial loss, may have combined with other circumstances to influence some operators to retire or caused some smaller operations to fold, even if the impact was not widespread. As one interviewee said,

> *"At what point does a person 'give it up?' The regulations probably helped pushe some out. They were small and less financially secure. Some sold for development. When the first nutrient management plans went into effect development was hot. Their land was taken up by other farmers."*
>
> *— Dick Willie*

At the same time, there were benefits in increased efficiency and reduced cost for others.

> *"If anything nutrient management planning made people a bit more profitable."*
>
> *— Ken Staver*

> *"(Required) nutrient management leveled the playing field. You had 60 percent of farmers with plans and the rest did not. Now everyone does. That is positive."*
>
> *— Marion Frye*

> *"Nutrient Management is more beneficial than not. Yes, it does add cost. But it's worthwhile for business management and the environment. People now know exactly what is in your soils and what crop needs are."*
>
> *— Marion Frye*

Livestock farmers have faced greater challenges with nutrient management than farmers using inorganic fertilizer products or chicken litter. Dairy manure takes up a large amount of space and is heavy and messy to transport. The huge "lagoons" required to store and treat the waste from larger operations can be financially unfeasible for some farmers, even with government cost share programs. When phosphorus-based nutrient management plans became required after 1998, dairy farms could no longer spread manure based on nitrogen content, resulting in an insufficient amount of nitrogen, the key plant food for corn. This change created both a need for more manure storage and a need to purchase nitrogen fertilizer. It seems certain that nutrient management regulations, particularly when phosphorus saturation became an issue, created real challenges for smaller dairy producers who had little land to absorb nutrients and less cash flow to afford large-scale manure storage. These factors most likely contributed to the overall decline in the number of dairy operations in the state.

Poultry litter has substantial economic value as fertilizer. Its nutrient value for nitrogen, phosphorus and potash is high. It provides high levels of organic matter that help build soil and is relatively dry and light weight. However, historically high rates of litter application to fields over many years has led to phosphorus hot spots where poultry litter application will have to be eliminated or greatly reduced. The 1998 regulations were largely pushed by the Pfiesteria outbreak that was linked to phosphorus from chicken litter.

While no studies were carried out regarding the impact of the 1998 regulations on farm loss, the consensus view from our interviews—supported by data from the U.S. Census of Agriculture—is that nutrient management regulations have not played an important role in farm survival overall. For instance, census data indicate that between 2002—the year that nutrient management regulations became fully effective—and 2007, the number of farms in Maryland actually increased by over 5 percent. Additionally, there were more farms in Maryland in 2012 than in 1997, the year nutrient management regulations were first proposed.

While Census of Agriculture data do show a reduction in the number of farms with sales between $100,000 and $500,000 from 1997 to 2012, they also show an almost equally sized increase in the number of farms with sales of $500,000 or more, so it's not clear whether the "smaller" farms were "forced out" or merely got bigger. Moreover, census data indicate a nationwide reduction in the number of farms grossing $100,000-$499,999 in sales, and most states do not have nutrient management regulations as stringent as Maryland's, if they have any such regulations at all. Going beyond agriculture for a moment, it's well recognized that many small businesses fail. There's no reason why small farming businesses should be exempt from that phenomenon.

Incorporating manure into the soil early in the crop season has several benefits for both the efficiency of nutrient use and water quality as compared to "broadcasting" manure on the surface of the whole field. It decreases the escape of nitrogen-rich ammonia gas into the atmosphere, providing more for the crop and reducing the odor. It decreases the potential for nitrogen and organic matter loss in storm events while maintaining more organic matter in the field. Thus, in nutrient use efficiency and the maintenance of soil productivity, incorporation of manure offers some benefits to the producer in annual and long-term profitability and productivity. On the downside, the equipment required is expensive and often specialized and thus not available for other tasks. A major drawback is that incorporation takes significantly longer than broadcasting at a critical time of the year when any delay in planting can negatively impact yields. In a wet year when farmers cannot access their fields early, this problem is exacerbated. For large grain operations that are planting thousands of acres, often in multiple locations, the time and cost constraints are considerable, even if farmers have the kind of equipment necessary. For smaller farms it may be difficult to access the equipment because of the purchase price and the lack of custom operators. Finally, incorporation also can cause soil erosion and can disrupt the full benefits of no-till depending on the equipment used.

> *"Our concern in mandating incorporation is that what we really need is injection. People didn't feel farmers could do it, too expensive. But we are going down a bad path. Disturbance is not good for soil, even vertical tillage."*
>
> *— Lynne Hoot*

All operations using manure for fertilizer will see increased costs in time, labor, fuel and record keeping resulting from the incorporation requirement. As before, the larger operations are more able to afford the costs and to make the most benefit out of them. These factors will impact profitability, which again will affect the smaller to mid-sized producers. Once again, dairy operations that lack of equipment for incorporation will suffer the most. But as with the other nutrient regulations, respondents did not feel that

incorporation requirements will "drive operations out of business."

> *"We didn't get complaints from larger operations. Smaller ones have less time to incorporate and cannot afford additional equipment. I've not heard of anyone going out of business. Heard extension people say that it could, but not seen it."*
>
> *—Buddy Hance*

> *"Most of those who have gotten out, was due to other issues. Labor in the dairy is a more significant factor (than this). People are (already) using more custom applicators."*
>
> *—Buddy Hance*

Two producers described incorporation as a strategy for better nitrogen efficiency.

> *"I am injecting the manure so I can capture that ammonia (i.e., for the nitrogen benefit)."*
>
> *—Sean Jones, 1,200 cow dairy*

> *"(Incorporation is) not such a big deal. Only if you are trying to be 100 percent no till. I don't want my nitrogen being lost anyway."*
>
> *— Luke Howard*

However, such views do not mean that the costs are trivial.

> *"Equipment is a big issue. Incorporation means more fuel, labor time, trips across field. Everyone doing it at the same time, which is the busiest time of the year."*
>
> *—Kurt Fuchs*

> *"Equipment and labor cost are issues."*
>
> *—Ken Staver*

BAN ON SPREADING MANURE, BIO-SOLIDS AND ORGANIC NUTRIENTS IN WINTER

The strictures on applying organic nutrients on fall crops and in the winter (no manure after November 1 on the Eastern Shore and November 15th on the Western Shore) further constrain livestock farmers, especially dairies. Farmers will face the cost of more storage and chafe at the rules mandating specific dates that may not coincide with actual weather conditions.

> *"The ban on winter fertilizer application is an extreme hardship in dairy. Have to build enough storage to handle November to March. Our lagoon (is so big it) looks like a football stadium. While it's never useful to spread on frozen ground, flexibility would be a huge benefit. We work with a nutrient management consultant. Here we are in mid-November (2015) with no hard freeze. Good opportunity to get manure on fields. Should base (the timing) on field and crop and weather. We need more flexibility."*
>
> *—Marion Fry*

On the assistance side, the Department of Agriculture is providing up to 87.5 percent cost share for waste storage, capped at $300,000 per farm. In 2014, the department also restored Maryland's Manure Matching Service, a phone-based system to connect farmers who have excess animal manure with other farmers or companies that can use the manure as a nutrient source. The service is voluntary, free and available to any animal producers with excess manure, including poultry, dairy, beef, hog and horse operations. As of 2014, eligible dairy farmers can qualify for up to $15,000 per season or $30,000 per year in cost-share assistance to transport manure.

2.1.6 Phosphorus Management

Regulations based on the new Phosphorus Management Tool (PMT) went into effect on June 8, 2015, by virtue of the Code of Maryland Regulations (COMAR) issued on April 3, 2015, which require use of the PMT to characterize

phosphorus loss that may occur in particulate and dissolved forms as well as from leaching. (The PMT is not itself a regulation.) The state had announced in 2010 that it would develop a new tool for determining phosphorus management in order to come into compliance with the EPA's TMDL. The PMT was the result of that effort. It replaced the existing Phosphorus Site Index (PSI) as a more accurate indicator of the potential risk of phosphorus loss from farms.

Application of the PMT results in elevated estimates of phosphorus runoff risk for many soils, implying much more widespread restrictions on cropland application of poultry litter as well as dairy manure. Fields with extremely high phosphorus loss will have to comply with PMT-based nutrient management immediately; those with high phosphorus runoff risk will have PMT-based nutrient management phased in beginning in 2018; those with medium phosphorus loss will have PMT-based nutrient management phased in beginning in 2019; and those with low phosphorus loss risk will have PMT-based nutrient management phased in beginning in 2020. The entire phase-in is to be completed by January 1, 2022.*

The state retained the services of the Business Economic and Community Network ("BEACON") at Salisbury University to produce a report on potential costs and benefits of the tool.

The report states that "the public will benefit from the proposal through improved water quality and environmental conditions in local rivers and streams. The quality of life of Marylanders will improve by virtue of healthy local water bodies and additional measures toward a restored Chesapeake Bay." It estimates $100 million in statewide economic benefits associated with implementing the PMT on the Eastern Shore, and cites an October 2014 Chesapeake Bay Foundation (CBF) report, *The Economic Benefits of Cleaning Up the Chesapeake Bay*, which attributes $4.6 billion of annual economic benefit to Maryland as result of meeting Bay restoration goals.

The BEACON report also identifies costs to farmers, notably that the PMT would have a $22.5 million per year negative impact on regulated industries, as farmers would be required to purchase inorganic commercial fertilizer to replace the nitrogen previously provided by manure. Conversely, it also estimates that there would be a positive $10.1 million impact on businesses involved in the transport of poultry litter.

The study, however, suffered from a number of factors that prevented a highly meaningful assessment of costs.

The project team engaged Dr. Erik Lichtenberg to provide an objective assessment against which to weigh observers' opinions. Lichtenberg's analysis combines two data sets. One was derived from soil test data, covering 875,622 acres on the Eastern Shore provided to MDA in 2016 under the new nutrient management regulations. The other is information used by the University of Maryland and University of Delaware to calculate the value of poultry litter as fertilizer†. The results of his calculations conform to those of earlier studies that found application to cropland as fertilizer to be the highest value use of poultry litter.‡ Based on this data, which identifies far lower phosphorus levels than previous estimates, and assuming that manure application rates allowed under the new PMT-based nutrient management regulations do not result in additional buildup of phosphorus in soils (as intended), then there would be more than enough cropland in the Maryland portion of the Eastern Shore to make it feasible to continue to apply all of the poultry litter produced to cropland raw as fertilizer. While a third of soil data remains to be analyzed, the analysis to date indicates that it is highly likely that there will be no need to increase the amount of poultry litter currently being transported off the Shore or to divert to new uses like waste-to-energy. The principal cost of a shift to PMT-based regulation is thus likely to be the somewhat higher costs of transporting a

* Maryland Department of Agriculture Nutrient Management Program, Maryland Nutrient Management News, Summer 2015.

† University of Maryland crop budgets for corn nutrient content test results.

‡ Erik Lichtenberg, Doug Parker, and Lori Lynch, "Economic Value of Poultry Litter in Alternative Uses," Center for Agricultural and Natural Resource Policy, Department of Agricultural and Resource Economics, University of Maryland, College Park, October 2002.

relatively small amount of poultry litter from the Lower Shore (where the amount of poultry litter produced exceeds the capacity of corn acreage to utilize it by a small margin) to the Upper Shore (which has substantial excess capacity for utilizing poultry litter).

Overall, the cost of the new nutrient management regulations is likely to be modest. Since there remains substantial excess capacity of cropland to utilize poultry litter at environmentally sustainable rates, that conclusion should hold even with adjustments for factors including some corn growers' unwillingness to accept poultry litter, costs due to the burden of additional paperwork, and remaining unknowns about actual soil phosphorus status, etc.

Shifting to PMT-based regulation might affect the relative bargaining power of sellers and buyers and thus the market price of poultry litter, at least on the Lower Shore. Under PSI-based regulation, there is substantially more corn acreage able to utilize poultry litter than the amount of poultry litter available, suggesting a seller's market (i.e., a higher price for poultry litter). Under PMT-based regulation, there may be a buyer's market (and thus a lower price for poultry litter) on the Lower Shore since less corn acreage will be able to utilize poultry litter. If such a change in the relative bargaining power of poultry producers and corn growers occurs, it will affect how the costs of new PMT-based regulations are distributed between the two groups but will not affect the overall cost of the regulations.

Expert Interview Comments on the PMT

Dr. Ken Staver, commenting on 2001 research he co-authored[35] and Dr. Lichtenberg's analysis, offered the following view: "There is a common misconception that imported grain is the big flow of phosphorus into the region, but in fact it was inorganic fertilizer P used in the Mid and Upper Shore. Phosphorus (P) in grain flows down the shore to the main chicken production region and most of it has not made it back. But the grain in Maryland Eastern Shore is not mostly coming from somewhere else. So the nutrient budget can be balanced if the P that goes down the shore just comes back up the shore."

He adds two caveats regarding the outcome of the PMT's effects. One is that the remaining soil results need to be collected and analyzed before final conclusions are reached. Secondly, "Manure is harder to manage from a nutrient loss standpoint than inorganic P, so nutrient losses will tend to go up in watersheds shifting from inorganic to manure. So it is important to do all basics in importing areas (i.e. in terms of best management practices). However, he concludes by saying, "It is a very long-term effort, but this model should work mostly, and probably is the least expensive."

Seven of nine respondents said that following PMT prescriptions will not put farmers out of business. Several cited the way the regulation was ultimately designed, with stakeholder participation and considerable time to adapt as a key factor in their support. Also, phosphorus would remain relatively cheap. Seven respondents also said that there will be real costs in expenses, time and paperwork.

> *"Not in and of itself put out of business. Will cost some money. Will cost row crop farmers in litter and org material. Effects on soil health.*
>
> *(But) Farmers will do what they always do—bright people will figure out how to capitalize on the situation. It's a winnowing process. Some are creative and can they can afford it."*
>
> *—Dick Willie*

> *"Phosphorus tools in the 90s. Changed way we farm. PMT may result in cost increase but not put out of business."*
>
> *—Luke Howard*

However, concern over impacts was expressed regarding large dairy producers, organic grain and grain producers changing management.

> *"We expect a lot of fallout for dairies. If you own land with high P and cannot apply manures, you need storage and you pay ten times more for pelleted fertilizer with no P. It's a significant monetary impact."*
>
> *—Marion Fry*

> *"The smaller dairyman that has been doing a good job moving manure around, I agree (will not have that much problem). For the larger dairy, especially those that are irrigating some liquid manure, it will have an impact. Poultry guys are used to loading manure on a truck and moving it around. Dairy manure is not that easy. Application timing limits fall application and will cause operations to build larger and larger storages. Another problem, if you need to export to a neighbor in the fall, they cannot receive if they are in the cover crop program."*
>
> *—Don Moore, AET Consulting*

Concerns were raised about economic impacts of the transition.

> *"The only cost effective way to grow organic grain is with chicken manure. On high P fields we lengthen our rotation with a second cereal grain. At (one) farm, we plant corn 1 out of 4 years. Profitability drops. Not want to complain, as organic farmer but it could limit expansion of organic production in MD due to profitability not cost."*
>
> *—Luke Howard*

The recurring theme was that there will be winners and losers. Farmers who own their own land and are no longer able to apply litter will need to purchase commercial N at a higher price per unit. But, they may be compensated at least in part by selling that litter to farmers whose land does not suffer from excessive phosphorus. Farmers who are unable to continue applying poultry litter to their fields will get assistance with transport but will also lose the soil health value of the litter's organic matter over time. Farmers who benefit from transport cost share may get the N at a lower cost as well as the added value of organic material. The fertilizer representative may well lose sales of phosphorus because the farmer now has a cheaper source.

> *"We have a lot of concern about the PMT. Not sure of the impacts. Some farmers will have to buy new equipment. Some will have to take just-purchased equipment out of service. What do they do with it? No local market for them. Is it paid for yet or does farmer still owe interest and capital on loan?"*
>
> *—Kurt Fuchs*

> *"We supported the changes in timing, ongoing reviews that include the environmental community."*
>
> *—Lynne Hoot*

> *"The first proposal would have had negative impacts because of the short timeline. Takes time to set up new relationships, new operations and adopt new technologies. Now because of the discussion, there is time for transition. In 10 years will say wasn't so bad."*
>
> *—Buddy Hance*

> *"If the PMT had gone in (as first proposed) there was no way to know who would take the litter at what price. Now the market will figure out who pays what."*
>
> *—Steve McHenry*

A key factor in the success of the PMT will be whether the amount of litter can be accommodated without requiring transportation to the Western Shore. MDA calculations suggest that there is enough or nearly enough acreage that can take additional litter. This view is supported and, in fact, strengthened by Lichtenberg's calculations, which are based on the conservative estimates of phosphorus status from Coale and McGrath as well as the most recent 2016 data from Eastern Shore soil samples.

Another factor affecting whether there are sufficient acres could be the willingness of producers in Upper Shore counties to accept the litter. Some may simply be satisfied with their current operation and choose to continue. Others may hesitate because of the reputation chicken litter has acquired as a noxious product.

> *"Farmers that don't currently use animal manure should use this as an opportunity for their soil. But media and groups have demonized poultry manure. Public sentiment may cause a Kent County Farmer to think, 'Why bring heat to my operation?'"*
>
> *—Kurt Fuchs*

As with the comments on nutrient management, respondents showed a strong consensus on the importance in how the regulation was developed and revised. Key points included the length of time for implementation, the commitment of cost share for transportation, and an on-going review process that includes environmental stakeholders.

The state will ease the economic burdens of implementing the phosphorus regulations in several ways. In 2014, MDA added $500,000 in state funding and secured additional support from poultry companies for the Manure Transport Program. The department also has pledged to provide the technical and financial resources needed to comply with new regulations.

2.2 Critical Area Act

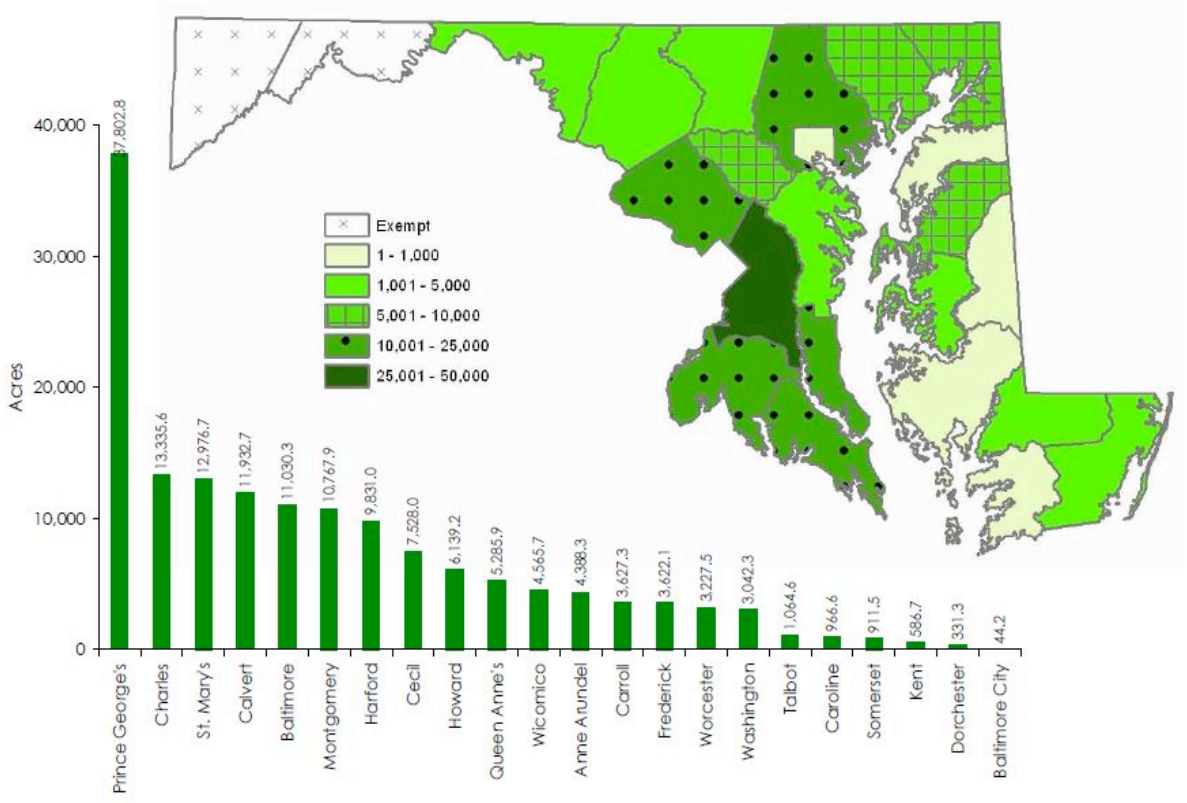
Adopted in 1984 as a result of the 1983 Chesapeake Bay Agreement, the Critical Area Act was an attempt to protect the Chesapeake Bay through the regulation of land use and development permits.[36] By 1984, it was clear that urban and suburban development was impacting waterways. Early drafts of the act proposed to establish land use and development regulations that would apply to all lands in the state. The final regulations apply to a 1,000-foot area measured inland from tidal waters and tidal wetlands, because land uses in these areas have the greatest impact on the waterways.

The act required all jurisdictions with lands within the Critical Area to adopt laws and development regulations that implement a special set of state regulations. Unique to this law, a Critical Area

Commission was created to implement the act rather than a state department. In 2008, the act was modified to give the Chesapeake Bay Commission authority to promulgate its own regulations.

The act calls for jurisdictions to classify all Critical Area lands into one of three categories: Intensely Developed Area (IDA), Limited Development Area (LDA) or Resource Conservation Area (RCA). Nearly all of the farmland and forestland in the Critical Areas is designated RCA; it applies to approximately 11 percent of the state or 680,000

Figure 2.0-1: Acres of Existing Forest Under Review by County Forest Conservation Programs 1993 to 2007



acres. Jurisdictions are permitted to convert up to 5 percent of their RCA lands to IDA or LDA, subject to state criteria.

The impact of the act on agriculture and forestry has been mixed. Existing farming operations within the Critical Area are allowed to continue and limited timber harvests are permitted.

A significant amount of farmland and forestland in the Critical Area remains today because of the Critical Area Act. Waterfront properties have always been valued for residential and commercial development. The act does not prohibit development in the RCA, but it requires that there be no net loss of woodland and it limits residential development to one house per 20 acres.

On the other hand, the act created a new level of regulatory oversight that adds costs and delays when farmers propose new buildings or loggers propose to conduct timber harvests. In addition, permission to develop lots at a density of one house per 20 acres further breaks up farm and forest lands.

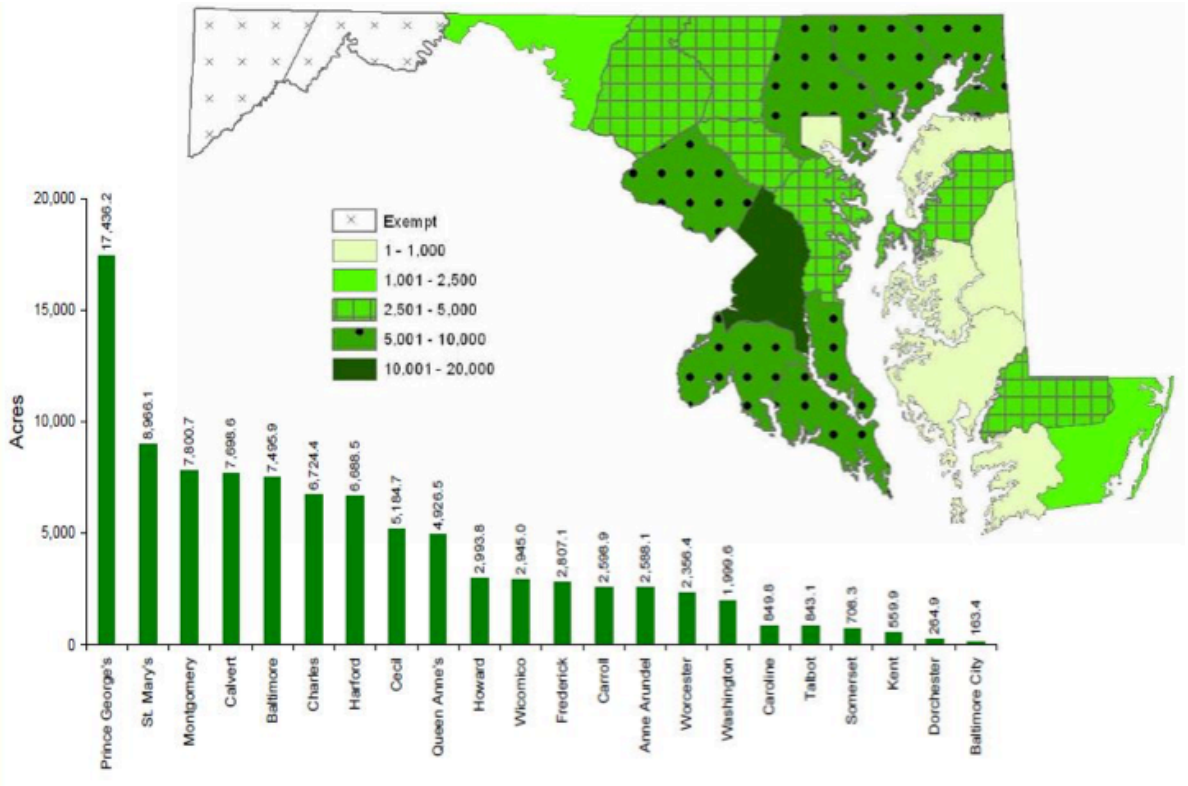
2.3 Forest Conservation Act

Because of rising concerns about the rapid loss of forestland due to development, the Maryland Forest Conservation Act (FCA) was enacted by the state legislature in 1991. Again, the origins of the act go all the way back to the first Chesapeake Bay agreements.

The objectives of the act are to minimize loss of forestland during development and to ensure that priority areas for forest retention and forest plantings are identified and protected during the development process.

The FCA is not intended to prevent development. Rather, it is intended to retain forest cover as properties develop and to require replacement when tree removal cannot be avoided. This is done through a variety of techniques including on-site

Figure 2.0-2: Acres of Forest Retained Under County Forest Conservation Programs 1993 to 2007



Forest Retention Areas, on-site afforestation, off-site Forest Retention Areas, off-site afforestation, and fees-in-lieu paid to the jurisdictions to plant trees elsewhere.

The Maryland Forest Service 15-year status report notes that between 1992 and 2007, the "FCA has been responsible for the review of 199,925 acres of forest on projects scheduled for development. Of those, 120,638 acres were retained, 71,885 acres were cleared and 21,461 acres were planted with new forest."

There is little doubt that more forest would have been cleared without the state and local programs enabled by the FCA, and that retaining forestland has many environmental benefits. The FCA also provides potential opportunities for the forest industry since timber harvests are permitted on FCA-protected properties. However, retained and planted FCA forests are typically in close proximity to developed land, so their economic viability may be impaired by neighbors' complaints and permitting procedures.

A recently completed study by Ferris and Newburn found evidence that the FCA has resulted in roughly 23 percent more forested cover within developed subdivisions in their study area, compared to the amount they would have expected without Maryland's Forest Conservation Act programs.[37] Their findings also suggest that the effects of FCA programs may differ, depending on the amount of forested cover present on the development site prior to development. Specifically, development sites with lower percentages of existing forest cover (between 0-60 percent) tended to show the greatest increases in forested cover compared to what would be expected without FCA programs. In contrast, development sites with higher percentages of existing forest cover tended to have significant decreases in forest cover that differed little from what was expected in the absence of these programs.

This differential effect suggests that FCA programs as currently implemented may not prevent continued loss and fragmentation of more extensive forested cover on developing land. This possibility is considered in Chapter 3 to help interpret the implications of projected land use change on the forestry industry.

An earlier study by Lichtenberg and Hardie[38] found that FCA requirements appear to influence developers' decisions to increase average lot size. They assess the notion that by doing so, the requirements could exacerbate sprawl by spreading market demand for residential lots over larger geographic areas: if you can't fit the number of lots demanded by the market on one development site, one might expect the "supplier"—i.e., the developer—to create more lots on additional development sites. However, the investigators found that the empirical data they examined did not support the idea that this phenomenon is occurring, and that the amount of land being developed to accommodate a given level of population growth overall did not appear to be increasing as a result of forest conservation programs.

2.4 What Agriculture and Forestry Industry Sectors Are Most Impacted by Maryland's Environmental Regulations?

The impact of new environmental regulations on forestry operations has not been addressed in the discussion thus far. Forestry operations are the least impacted by the nutrient management regulations discussed in this report because forests generate very low nutrient and phosphorus loads. If landowners do not use chemical fertilizer, manure or bio-solids in the production of trees, then they do not need to develop a nutrient management plan.* With an effective sediment and erosion control plan in place, forests produce low sediment loads.

For forestry operations, the biggest regulatory impact is on the complexity of every county having a different approach (and cost) to sediment and erosion permits. According to University of Maryland Extension, in 2014 the costs of a sediment and erosion permit varied from zero in some counties to over $450 in others, with each county having a slightly different process.† To add to the complexity, there were waiting periods ranging from none to as much as 4-6 weeks in some counties. Submittal requirements generally must include several maps showing the harvest area and landing locations, road entrances, and soil and topographic maps. These may need to be provided along with the standard erosion and sediment control plan and drawings of road entrances or stream crossings. Several copies of the application may be required. This can be a level of complexity that is daunting for small woodland owners unless they seek professional help to plan, permit and oversee the harvest.

AGRICULTURE: The primary thrust of agricultural regulation that focuses on Bay restoration is on managing nutrients, both inorganic and organic, and reducing their escape into the environment. Since all types of agriculture utilize nutrients in some form, every type of agriculture has been impacted by the series of regulations implemented since 1998. However, since commercial nitrogen is comparatively easy to measure and apply and is amenable to various methods of precision applications, regulations addressing it are the easiest to adapt to, notwithstanding the fact that there are real costs. Managing manure is more complicated, cumbersome and expensive. It also involves the issues of phosphorus and over-saturation of soils, which have occurred over long stretches of time and will require considerable time to address. Of the operations using manure, it is those that confine their animals on a large scale—dairy and poultry—that face the greatest challenge in meeting Maryland's environmental regulations; between the two, dairy operations are the most impacted.

* Section15.20.07.04 of the annotated code.

† University of Maryland, "Green Book 2014: How to Apply for Woodland Harvest Permits in Maryland." Extension Bulleting EB-417, February 2014.

Virtually all of the regulations involving manure management involve reducing the amount of manure applied, the area on which it can be applied it, the timing or when it can be applied, or the equipment needed to apply it. All of these requirements increase the amount and length of time that the manure must be stored. The dairy industry will continue to bear the biggest burden. As noted in the 2013 Dairy Report,[39] "Maryland's dairy farms could face huge hurdles as dairy manure is primarily liquid and is difficult to transport any significant distance." Mark Powell, Maryland Department of Agriculture, noted that "investment in facilities is a financial challenge for dairy farmers, even with cost share." Given that these pressures come at a time of decline for the industry, the regulations could well exacerbate the trend. Geographically, the Eastern Shore and Frederick County will be the most impacted.

The poultry industry, especially on the Lower Eastern Shore, will be impacted by the phosphorus management regulations at every level. It will affect poultry growers and grain growers who will need to change fertilizer sources, negotiate transportation of litter between farms and all of the components in the integrated web of the chicken industry. Impacts will be heaviest where the soils have been receiving litter for the longest time in the largest quantities: the Lower Shore Counties. The impact will be on the operations that have used litter as their primary source of nutrients and organic matter.

An alternative to storage (at least in part) is to haul manure away from their farms to be used elsewhere. The state Manure Transportation Project mitigates that problem for poultry and livestock producers. It provides cost share to assist in the transportation of poultry or livestock manure from farms.* But additional problems still arise since the farmers will likely need to substitute commercial fertilizer to supply the nitrogen they previously got "for free." Poultry and livestock farmers apply manure to their fields because manure is a good nutrient source: it increases organic matter in the soil, and farm field application is a convenient location for disposing of animal waste. When nutrients from the manure exceed uptake by farm crops, then the nutrient management plans and the PMT require farmers to limit manure application if the nutrient buildup impacts the environment.

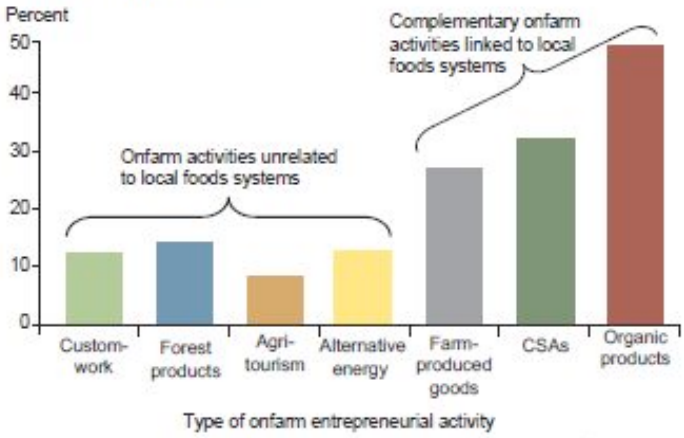
2.5 Permitting Complexity in Attempting to Regulate for Health, Safety and Welfare

Towns and cities are magnets for economic activity for many reasons. Industries and technology centers locate where there are robust infrastructure, facilities and transportation hubs and potential employees. More business activity in one place creates synergies and innovation. Job seekers are drawn to the job opportunities and an increased number of cultural, entertainment and sports activities, particularly in major cities. However, development in rural areas is associated with greater impacts on land and water and greater tensions between neighbors and/or between non-compatible land uses. Striking the right balance between property rights and protection of the public interest is a more daunting task in urbanizing areas.

The fifth most densely populated state, Maryland—and its counties and municipalities—have adopted numerous plans and regulations to promote health, safety and welfare, and to implement plans intended to protect quality of life. Many effective programs at the state and local level have reduced the loss of farmland and forestland and degradation of the Bay. However, there is always a danger that regulation can stifle quality of life and chase away the industries that they were meant to protect. In addition, regulations can become out-of-date or out of sync with the latest trends.

* Agriculture Article, §8-704.2, Annotated Code of Maryland.

Figure 2.0-3: USDA, Small Farms with Direct Sales—Percent that Engage in Entrepreneurial Activities



Source: USDA, Economic Research Service analysis of USDA, National Agricultural Statistics Service, 2007 Census of Agriculture data.

Figure 2.0-4: Owners of Evergreen Organic Farm Eventually Left the Farm after Experiencing Difficulties Getting Permits

Ted Wycall; his wife; Julie; and 14-month daughter inspect the winter greens in a hoop house at his Greenbranch Organic Farm on Maryland's Eastern Shore. (Dave Harp)

Zoning and Land Use Patterns Preventing Access to Markets

Maryland farms are much smaller than the national average. To survive in a world of global competition, operators of small- and medium-sized farms have been trying to increase the value of their farm products through various entrepreneurial activities. This is evidenced by the growth of wineries, creameries, grain mills, and producers of jams and jellies and so on. In addition, some farmers have tried to sell more of their products retail, rather than wholesale, to get a larger share of the food dollar.

Each Maryland municipality has its own comprehensive plans and zoning regulations to govern land use and development. Most were adopted in the 1960s and 1970s. In many ways, old zoning ordinances treated agricultural zoning districts as leftover zones. Residential zones were for residential uses. Commercial zones were for commercial uses. Industrial zones were for industrial uses. Agricultural zones were for agriculture, forestry and all uses that did not fit in the other categories, such as landfills, churches, schools, sewage treatment plants, etc. Low density residential development was also allowed.

Over time, more and more land in agricultural zones was used for non-agricultural uses—especially residential development. This drove up the value of land and created land use conflicts between farmers and others. New residents who moved into rural areas raised concerns about agricultural uses, leading to zoning regulations that can make it more difficult for farmers to farm and to establish value-added and agritourism uses.

The local food movement emerged in the 1990s into a hostile regulatory environment and unfavorable marketing environment. Existing zoning regulations did not permit value-added production and direct sales of products in designated agricultural districts. Farmers who wanted to sell to consumers could not get their products onto the shelves in chain grocery stores because they were not growing at a scale to interest chain buyers.

In recent years, there has been a symbolic effort to feature locally produced food on grocery store shelves, but "local" is considered within 400 miles;[40] farmers who rely on these high-volume markets often find their contracts terminated when a cheaper product is found somewhere else. Long gone are most of the local grocery stores located on town or city main streets that used to sell local fruits, vegetables, meats and dairy products.

In 1948, there were 504,439 food stores in the U.S[41] serving 146.6 million residents. Since 1950, they have been replaced by grocery chains and other commercial centers. The Food Marketing Institute reports that there were 37,459 chain supermarkets and 40,000 independent food stores[42] in 2013 serving a U.S. population of 320 million residents. Supermarket chains operate at a very low profit margin and at a volume that limits the use of goods from small- to mid-scale operations. In essence, it is much easier for a tomato from Mexico to sit on grocery shelf in Maryland than a tomato from a farm two miles away.

Direct sales allow local farmers to gain a much larger share of the food dollar. To help farmers gain access to consumers, local jurisdictions began making farmers markets a permitted use in their zoning ordinances. This has been a step in the right direction, though it still does not give farmers access to commercial centers where most consumers purchase their groceries. Typically, farmers markets are located in parking lots on the edge of most commercial activities. Often, the use is a special exception, requiring a public hearing and the approval of a board of appeals. As per a USDA publication, "The most commonly encountered local policy issues relating to farmers' markets are operational questions, such as where the market can operate, parking, security and conflicts with adjacent businesses. These policies can be significant factors in determining the success and existence of a market. Cities also address issues related to the regulation of farmers' markets, such as the need for permits, zoning exceptions, or approval of a market ordinance."[43]

Some jurisdictions have specifically allowed value-added production, direct-sales from the farm, and agritourism in their agricultural zones. But zoning reform is not widespread. When farmers are forced to try to gain approvals under the broad definition of "agriculture," they can run into further problems. Even if they obtain approval from a supportive zoning official, neighbors may appeal the approvals, making farmers subject to court rulings for which the judge or jury must interpret vague regulations.

Even if the proposed use is deemed a permitted use, permitting requirements can be a major hurdle. If the public is invited onto the property, many jurisdictions require designated parking areas and buildings that meet commercial design specifications. If customers will be entering farm buildings, state law may require that the building have a sprinkler system, along with a large water tank, to provide water for fire suppression. Public bathrooms may be required. If the property fronts on a public road, the jurisdiction may require major entrance upgrades and deceleration lanes, depending on anticipated traffic volumes. When commercial design standards are required, there is a risk that the farm will lose its rural appearance. While commercial developers will be familiar with such site plan requirements, the development process is entirely new to farmers.

Finally, farmers have to determine which regulations apply to their new development and/or farm processing operation and who is responsible for their enforcement. This can lead to unexpected costs and even teardowns and redesigns. Some local jurisdictions do a great job of coordinating between all levels of government and making sure that farmers get one answer that they can rely on. In other counties, reviewing agencies work in silos, to the great frustration of applicants.

Despite all these challenges, some farmers are succeeding with direct sales to consumers from their farms. And small retail outlets that feature local foods in towns and cities are becoming popular. "Perhaps most remarkable has been the growth of specialty food stores, such as bakeries and greengrocers. The Census showed a net gain of over 1,400 small specialty food retailers (those with fewer than 20 employees). Sales at these stores shot up 23 percent even as grocery sales overall grew just 3 percent. This trend likely reflects increased public interest in locally produced foods, as well as a growing desire to shop at neighborhood stores."[44]

Health Regulations — Who Is in Charge?

It is not clear who is in charge of health regulations, and what their impacts and implications may be for the sustainability of Maryland farming. Untangling the web of federal, state and local controls and determining which have the most significant effects on farmers is beyond the scope of this study. However, we believe that these regulatory requirements and constraints may have significant influence on the future of sustainable farming in Maryland; we include the following general discussion to indicate why that may be so, particularly for emerging markets.

Most farmers are not in the food preparation business. However, there is movement nationally and in Maryland toward more direct farm-to-consumer marketing and farm-to-local and regional middlemen—through what are called local and regional food networks—for produce, fruit, and animal products.

National and corporate middlemen are used to employ practices and techniques designed to fulfill these requirements as matters of their business routine. Beginning farmers and those seeking higher profits through direct sales are not.

How significant are these effects? We suspect that the answer relies less on the current size of these emerging markets, which is relatively small, and more on the degree to which these rules and requirements present obstacles to emergence of these markets: specifically, how much is their growth being slowed or constrained by these regulations. A recent analysis of data from a survey of Mid-Atlantic produce growers by Lichtenberg and Tselepidakis[45] suggests that most growers in the region will either be exempt from the Produce Rule or will benefit from extended time to come into compliance. While large numbers of growers already use the kinds of practices required by the rule, many do not. Compliance costs exhibit substantial economies of scale, so that compliance is considerably cheaper for large operations than for small ones.

There are federal, state, and local agencies responsible for enforcing at least some aspect of food preparation and service rules. To quote from a USDA report, "Uncertainties exist in regulatory scope and enforcement jurisdiction of local food requirements across State, County, and municipal lines, as well as between Federal agencies which may impede the flow of information between various regulators. For example, what may be a 'voluntary' food safety requirement by the Federal Government may not be interpreted as such by enforcing authorities at the State level."[46]

As per the Maryland Health Care webpage, "Local health administration preceded the organization of a State health department by nearly a century, when, in 1793, Baltimore City established a health office to stop an epidemic of yellow fever."* That level of independence still exists. The first county health department was formed by Allegany County in 1922 and, by 1934, each Maryland county had its own health department. Health services were reorganized a few more times over the decades and, today, local health departments are supervised by the Public Health Services of the Maryland Department of Health and Mental Hygiene. Each local health department administers and enforces state, county and municipal health laws, regulations, and programs. Funding is typically shared by the state and local jurisdiction. "By law, the Department of Health and Mental Hygiene annually provides matching funds to Maryland's twenty-four local health departments for certain health services."†

In Maryland, each county has its own state health officer with a significant level of autonomy. The health officer oversees food safety anywhere that food is prepared for and/or served to the public, including farmers markets, farm kitchens and roadside stands. The Maryland Department of Agriculture provides food safety training for farmers.

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* See Local Health Department Funding on the Maryland Manual Online: http://msa.maryland.gov/msa/mdmanual/16dhmh/html/16agenph.html.

† Ibid

For farmers, questions can arise as to whose regulations take precedence. Interpretation of health regulations often differ from county to county. Again quoting the USDA report, "Costs and uncertainties related to food safety and processing regulations affect direct-to-consumer marketing activities across State, county, and municipal boundaries, especially on-farm production and post-harvest handling practices. For example, there may be costs related to complying with State rules on processing, and uncertainty about whether direct farm sales are exempt from existing food safety and processing regulations in certain locations. Clearly stated health and safety rules and licensing and inspection requirements can facilitate the successful operation of farmers' markets."[47]

Echoing numerous anecdotal reports, the Maryland Agriculture Commission livestock representative Bill Edwards commented that producers of cattle, sheep, goats and hogs who are actively trying to increase local retail sales face impediments to expanding what is otherwise a promising market.

He cites a decrease in USDA-inspected meat slaughtering and processing facilities in Maryland due to increased costs from state and federal health and zoning regulations. More livestock producers now haul their livestock out of state, at greater expense and missing opportunities to grow the industry at home. Two lists found online show a total of 22 slaughtering facilities in Maryland in 2009 and 13 in 2014.[48]

Additional constraints on the local meat industry arise from differing state and county health inspection regulations. For example, many farmers producing for this market are required to have a state of Maryland Department of Health & Mental Hygiene-issued license. But some counties do not recognize the state issued license, requiring producers to purchase a separate Producer Mobile Farmers Market license.

Producers wanting to sell in multiple counties find that while the State Health Department and some counties allow frozen meat products to be transported and sold from iced down coolers, others, such as Anne Arundel, require expensive NSF International-approved freezers. A Department of health contact stated that many of these issues have been clarified and suggested that producers encountering problems call Annapolis.

Barriers and Progress in Accessing the Green Building and Green Energy Movements for the Forest Industry

On February 15, 2015, the St. Louis Post-Dispatch[49] noted that "Industry analysts estimate that green building accounted for 44 to 48 percent of nonresidential construction in 2014, a market share worth roughly $140 billion. In 2005, it accounted for only 2 percent of nonresidential construction. Green building had a slower start in home construction but still accounted for 23 percent of all new homes built in 2013, according to McGraw-Hill Construction."[50] Green building regulations give points to builders who locally source materials, thus reducing greenhouse gas emissions. That type of incentive should benefit Maryland's forestry industries. However, access to both these markets has been blocked in the past.

Green building projects are increasingly popular in in the private sector, and there are some Maryland public buildings that are required by state law to be constructed under a green certification process. However, for years, Maryland's forest industry has not been able to benefit from these opportunities. The Sustainable Forestry Initiative (SFI) is a major certifier of sustainable forestry eligible for use in "green buildings" such as LEED. According to the Maryland Department of Natural Resources report *The Industry of Maryland's Forests*, the Maryland Green Building Council only recognizes LEED as the "Green Building" certification in Maryland, and LEED recognizes and gives credit only to wood rated by the Forest Stewardship Council (FSC). The report notes that "The vast majority of Maryland forest landowners cannot obtain FSC certification because it is cost prohibitive. [Because most privately owned forest parcels are relatively small.] An alternative woodlot certification developed by the American Tree Farm System, which is much simpler and less

expensive to obtain, is not recognized by either the MD-GBC or the state, putting most owners of the hundreds of small tree farms in Maryland at a distinct market disadvantage.

However, Department of Forestry discussions with MD-GBC led to amendments in the guidelines for state buildings in the summer of 2015 that now allow credit for materials locally sourced within 100 miles. As of this writing, DNR is working to provide the MD-GBC with a list of Maryland mills and the products they supply so that locally sourced materials can be more readily identified.

Progress Continues to Be Slow in Green Energy

In 2012 the Maryland Wood Energy Coalition prepared a "Prospectus for Advancing Bio-Thermal Energy in Maryland." It identified a number of findings about why utilization of wood as a heating source is not more widespread, including:

- Maryland Public Service Commission net metering and interconnection policies do not allow the development of combined heat and power (CHP) projects.
- Renewable thermal energy from CHP and straight thermal biomass technologies do not currently qualify to generate renewable energy credits (RECs) under Maryland's renewable portfolio standard (RPS).

To summarize the bottom line about Permitting Complexity, Section 2.5, effective regulations are needed to protect public health, safety and welfare, particularly in growing urbanizing areas with diverse land uses around a large estuary. However, as this section highlights, those who are regulated may experience the requirements as confining, cumbersome and economically impractical. Over time, such measures can become out-of-synch with current conditions and/or emerging trends. There is a tendency for federal, state and county agencies to operate independently, which can be very frustrating for farmers and owners of farm support businesses when requirements from more than one level of government simultaneously govern their choices.

Figure 2.0-5: Wood-based Power Plant

This wood-based 4 MW CHP plant on the Lower Eastern Shore has operated since the 1980s providing heat and electricity to the ECI correctional institution.

When regulations and policies are developed and updated with sound data and collaboration among agencies and stakeholders, they are better received and more effective. Our expert interviews generally praised Maryland's deliberate approach to developing regulations for nutrient management and the PMT. The Department of Natural Resources worked to negotiate a path for Maryland forest owners to benefit from green building, and that effort seems to be bearing fruit.

Thus, the point seems to be twofold. First, if regulatory processes are not conducted carefully with respect to these issues, they can discourage rural industries and stifle their economies. But these effects can be minimized with appropriate levels of attention, and Maryland is having some success in these regards.

2.6 Competitive Advantage

Competitive advantage occurs when a farming region has an attribute or combination of attributes that allows it to outperform other farming regions. These attributes can include better access to markets, better transportations

systems, better or cheaper labor, lower taxes, longer growing seasons, etc. Changes in these attributes can improve or repress agricultural or forest industry prospects.

As noted in Chapter 1, water access, rail access and market access all played roles in the early success of Maryland agriculture and forestry. In the twenty-first century, their main competitive advantage may be proximity to the growing and relatively affluent cities and suburbs of Washington, D.C., Baltimore, Philadelphia and New York City.

Maryland currently maintains a level of competitive advantage in several areas of agricultural production.

Poultry

The Delmarva Peninsula and Maryland's portion of it can be considered an integrated poultry production region that grows corn and soybeans for feed, raises meat and egg animals with that feed, and returns the manure from those animals back to cropland as fertilizer. Proximity means that producers on the Eastern Shore can sell grain at a premium and the poultry companies pay lower transportation costs to ship it.

The ability to use poultry manure for fertilizer provides competitive advantage. Poultry manure is high in nitrogen and phosphorus content and it contains organic matter that is beneficial for soils. It also costs less to provide the necessary nutrients for grain production than chemical fertilizers. However, excess use of manure on farm fields can cause very high nutrient levels in the soils, which pollute waterways. According to a 2003 USDA ERS report, 152 counties "have county-level excesses of phosphorus, mainly in western Virginia, Delaware and eastern Maryland, eastern North Carolina, northern Georgia and Alabama, central Mississippi, western Arkansas, and southern California."[51]

If Maryland's nutrient management regulations are able to control nutrient loads such that manure can continue to be applied on grain fields, then that will remain an economic advantage for the poultry industry.

The Local Food Movement

Proximity to the region's urban areas gives a competitive advantage to wineries, creameries and fruit and vegetable growers who sell directly to consumers, particularly farms on the Western Shore. In fact, virtually all of Maryland's agricultural sectors have felt some benefit, including protein producers (beef, pork, chicken, turkey, sheep, goats, cheese, aquaculture, etc.) who prepare their products for market.

However, Low and Vogel indicate that farmers need to reach secondary markets, not just direct sales, to capture a significant share of the local food market. "Despite increased production and consumer interest, locally grown food accounts for a small segment of U.S. agriculture. For local foods production to continue to grow, marketing channels and supply chain infrastructure must deepen."[52] That requires adequate aggregation and distribution systems, which are thus far not sufficient for the task.

Climate Change and Global Uncertainty

As mentioned in Chapter 1, climate change may provide some form of competitive advantage for Maryland farmers if USDA's climate projections described in Chapter 1 hold true. Maryland farmers and foresters will be affected but not as radically as some other parts of the country.

Terrorist threats, wars and political unrest can also cause citizens to turn inward and rely less on global markets. The risk of food insecurity may create stronger local markets.

2.7 Summary

Six states and the District of Columbia contribute to the pollution of the Chesapeake Bay and are responsible for compliance with the Clean Water Act. Some might say that Maryland and Virginia have the most to benefit since their residents have the most access to the Bay. Maryland has

been the most proactive in controlling pollutants and in modifying its development regulations to promote smart growth. The latter, plus Maryland's land preservation programs, have gone a long way toward protecting agriculture and forestry resources for the future. Maryland was more successful than the five other Bay watershed states and the District of Columbia in meeting the EPA nutrient reduction goals by 2013.

However, many farmers begrudge the challenges they face in complying with the myriad of environmental regulations, and they fear that the time and cost of compliance will put them at an economic disadvantage with their competitors. To address the costs of higher environmental standards imposed on farmers in Maryland, the legislature has helped farmers to comply by providing financial assistance for programs that reduce nutrient loads from farms.

If Maryland's citizens want a healthier Bay and for farming to be economically viable, its elected officials and citizens will need to continue public financial support for nutrient reduction on farms at least until all other Bay states are required to institute their own effective nutrient reduction programs.

The changes in agricultural regulation in the last 17 years have been significant, affecting all types of operations in every sector of the industry. It has caused major changes in basic operations such as nutrient management and manure storage, and where and when operations can take place. There were considerable claims that these changes, implemented in the cause of Bay restoration, would lead to the ruination of farming and forestry. From our vantage point, those fears appear to have been overly pessimistic. Between 1985 and 2015, Maryland farmers have been able to achieve 91 percent of the state's 2017 nitrogen reduction target and 122 percent of its 2017 phosphorus reduction[53] while remaining the state's largest industry.

According to our key informants, this has been due in large part to the way the regulations were implemented, allowing sufficient time for implementation for different parts of the industry (finance, equipment, product suppliers) to adapt. Cost-share dollars generously provided by the taxpayers have also been key. And, according to our interviews, negotiations among a diversity of stakeholders have been important.

This is not to say that the journey has been smooth or without casualties. The impetus for the 1998 round of regulation was precipitated by a frightening public health menace, Pfiesteria, which brought long simmering differences between the agricultural and environmental communities to a boil. The fallout from that experience reverberates today. In the end, however, the process that was put in place earned praise.

While the regulation of agriculture may not have caused widespread bankruptcies, it has undoubtedly increased costs, labor, administrative time, and time spent for training and certifications. It has pushed greater expenditures in technology, including new equipment. The regulations and the social context around them have resulted in farmers feeling demonized and persecuted. They feel that the addition of new regulations is relentless, that the "goal line" continues to be moved back, and that the scientific basis for specific requirements is lacking.

So far, the industry has withstood these pressures. While it may not be possible to attach numbers to the impacts, it is highly likely that the regulations so far did, in combination with other factors, contribute to the loss of some farming operations, particularly in the middle-size range and in the dairy industry. Maryland's agriculture has become more consolidated with larger operations at one end of the scale (though there are more small farms at the other). This type of consolidation has occurred in most of the country, so there may not be an easy way to determine how much of an impact the regulatory environment had.

The next phase does have the potential to be more disruptive simply because previous iterations have already caused belt tightening. Implementation of phosphorus regulations based on the PMT will impact thousands of farms on the Eastern

Shore and elsewhere and other entities in the agribusiness ecosystem. So far, the project team has discerned that there is a good possibility that sufficient acres will exist to absorb the amount of litter that must be relocated. The supports for transportation are going into an already existing system. There is considerable research into and experimentation with technologies that can remove phosphorus from drainage systems and others that can convert waste into energy. Note that all produce a byproduct that is high in P and will need a market to address the nutrient imbalance issue. If the effort is successful, it could become an example of how to establish a sustainable grain-poultry system for the first time.

Potential barriers include the following:

- Determining whether or not there will be sufficient acreage for displaced litter by determining the physical location of P saturated soils and convincing producers who could utilize chicken litter in their operations to do so.
- Having farmers with P saturated soils find profitable crops that can be successfully grown without additional phosphorus applications beyond what is available in the soil.

Other considerations called for in the interviews

- Continued will to fund restoration on agricultural lands with tax-funded cost share.
- Investing in extension and the science they need.
- Continued dialogue about programs and potential new regulations.
- A "time out" from new regulations for a while?

Overview/ Synopsis of Results

Our take-away with respect to the impacts of the programs on the sustainability of agriculture is that the different policies/regulations impacted the industry both positively and negatively. Impacts were not as bad as people in the industry predicted they would be, but they did have negative outcomes that the regulation proponents probably did not anticipate.

1. REQUIRED NUTRIENT MANAGEMENT PLANNING

Generally Positive Outcomes

- Producers increased nutrient use efficiency (NUE) at a cost savings for fertilizer.
- Paying more attention to nutrient management benefitted overall farm management and efficiency.
- Producers invested in products and equipment that increased NUE and production efficiency (precision equipment and technology, manure incorporation, irrigation).
- Our general view is that nutrient management has not been a major factor driving farmers out of the business. Though perhaps not happily most producers adapted to the requirements.
- Nutrient losses to the environment were reduced. (It's unclear how much reduction was achieved; the results are still under analysis.)

More Negative Outcomes:

- The time needed for reporting and paperwork is a cost. For some farms, a nutrient management plan does not change actual practices; it only adds administrative work.
- The costs of nutrient management may have contributed to the end of some farm operations (smaller/less efficient, undercapitalized, older landowners) and to the consolidation of smaller farms into larger farms.

Manure Incorporation in 48 Hours

Generally Positive Outcomes:

- Incorporation below the soil surface minimizes chances for runoff and improves nutrient use efficiency by reducing ammonia volatilization, meaning more N for the plant and less to run off, and locates nutrients closer to the root zone.
- It benefits soil health by increasing subsoil organic matter.
- A reduction in odors may improve the relationship between farmers and their neighbors.
- Litter tillage equipment creates a good planting bed.

More Negative Outcomes:

- Incorporation is costly. The equipment is expensive to purchase or hire. Fuel costs and equipment maintenance increase. Costs may contribute to a loss of smaller/marginally profitable operations and consolidation of farms.
- Greater efficiency means less product applied, leaving more manure to be stored or transported.
- The operation occurs prior to planting, the busiest time of the year and most susceptible to wet weather and associated planting delays that can seriously affect yield.
- Dairy farms experience disproportionate burden from this requirement compared to operations using poultry litter due to the physical and financial challenge of transporting the liquid content and higher P to N ratio.
- Some forms of incorporation can increase soil and nutrient loss compared to no till.

2. PHOSPHORUS RESTRICTIONS BASED ON ASSESSMENTS USING THE PMT

Generally Positive Outcomes:

- The restrictions will result in a distribution of high quality organic matter and nutrients (N, P, & K & micro) more widely across Eastern Shore acres. Soils will benefit.
- N and K will be available to some farmers at a competitive price.
- Application on low P soils could improve the mass balance of nutrients on the Eastern Shore, potentially enabling a sustainable grain-organic nutrient-poultry system

More Negative Outcomes:

- Fertilizer costs rise for farms that must reduce or eliminate manure applications.
- Some producers will need to purchase or rent equipment to utilize litter.
- The negative stigma of litter may reduce available acres for application in low P areas.
- High P soils could require longer crop rotations and alternative crops, reducing profitability when certain high value crops (i.e., organic grain, some vegetables) can be grown less often. The regulations could result in limiting the spread of these crops to high P areas.

3. EPA TMDLS WATERSHED IMPLEMENTATION (WIP) PROGRAM

Respondents did not have much to say regarding the WIPS, presumably because they interact with environmental regulations and objectives more through specific state programs but have little direct exposure to these watershed plans.

Chapter 3: Implications of Smart Growth Initiatives and Land Use Change for Agricultural and Forest Industries

How much farm and forest land in Maryland will be converted to development over the next 25 years? Where will it happen? Do smart growth tools emphasized by state and local governments matter? How will factors other than development—such as climate change and implementation of certain Best Management Practices under Maryland's Watershed Implementation Plan for the Chesapeake Bay TMDL—affect resource lands? And finally, how will this confluence of impacts affect resource industries and the types of farming and forestry that will remain profitable and sustainable as defined for this project?

We do not presume definitive answers to these questions, but identify changes in land use that are likely to occur based on recent development patterns and existing land use management tools, and suggest possible associated effects on resource industries that may occur in conjunction with other factors considered in this report: recent market trends, emerging opportunities, and influence of regulations related to Bay restoration and smart growth initiatives. In this chapter, we also consider some of the major factors that have historically underlain land use change in Maryland; estimate future land use change; and examine how past land use changes may have affected farm and forest industries, to help interpret implications of future estimates.

3.1 Factors Affecting Growth, Development and Associated Land Use Change

Most direct governmental authority for where, what type and how much growth and development can occur in Maryland resides with local governments. The state is responsible for guidelines and technical and financial assistance; some infrastructure and other capital funding: environmental regulations for specific aspects of development and land use management process as authorized in state law; and for establishing and changing the laws that ultimately allocate relevant authorities and responsibilities between state and local governments. But the vast majority of implementation responsibility rests with local government.

Particularly important for this study are local government responsibilities for implementation of most state smart growth initiatives, including the Economic Growth, Resource Protection, and Planning Act of 1992; the 1997 Priority Funding Areas Act; the Agricultural Stewardship Act of 2006; and the Sustainable Growth and Agricultural Land Preservation Act of 2012. These implementation responsibilities are generally fulfilled through local comprehensive plans, zoning maps and ordinances, water and sewer plans, and development and related environmental regulations typically associated with subdivision and development process. State agencies and programs have significant roles for implementation of some of these initiatives, but local governments are the primary agents.

For purposes of this project, this arrangement of state and local responsibilities means that, in attempting to project future land use change, it is essential to represent the local tools through which land use management and state policies are implemented. We attempt to do so through data and analysis discussed in the last section of this chapter: *Methods: Estimating Future Growth, Development and Land Use Change*.

The effects and influence of local land use management tools is pervasive. Comprehensive and water and sewer plans and zoning maps and ordinances dictate to fairly significant

degrees what types of development can occur and where, and to some degree how much of it. Zoning ordinances and development regulations influence details about what happens on individual development sites, and how it relates to existing land uses and land cover types on and surrounding development sites.

Another enormously important factor influencing where and how growth occurs is market forces, specifically, where are people and companies actually developing land and buying or leasing developed real estate products? Market forces respond to and sometimes push the limits of development guidelines established by state and local land use management policy and tools. They are represented in the study in three ways: geographic-specific forecasts that consider these factors; an extrapolation of recent trends; and a proximity analysis, i.e., how close are developable lands to features that increase chances of development. Procedures to represent these factors are also discussed in the *Methods* section.

A third factor that must be considered in estimating future growth is the question of magnitude: how much new development is likely to occur? This is addressed through projections, or forecasts of growth in population, households and employment. Speaking generally based on past projections, the larger the geographic scale of projections (e.g., projections for the whole state versus for an individual county) and the nearer the target year of the projection (for 5 years from now rather than 30), the more accurate the projections are likely to be.

For example, statewide population projections for 2010 made shortly after release of the 2000 Census turned out to be within a few percentage points of the population increase ultimately measured by the 2010 Census. Projections for some individual areas can be far less accurate. Projections for 20, 30 and 40 years in the future, even at statewide scales, can be less accurate if a fundamental societal behavior or economic factor changes in an unanticipated way; for example, many people choose to marry and have children later, or the baby boom changes to a baby bust, or immigration policy changes.

These potential sources of inaccuracy notwithstanding, projected changes in population and employment are necessary to make estimates of potential land change. While the "accuracy" of 2040 projections used for this project can't be known at this time, the projections are made to be as accurate as possible given the information available, as discussed further in the *Methods* section.

In summary, estimates of land use change to 2040 in this report are primarily a function of:

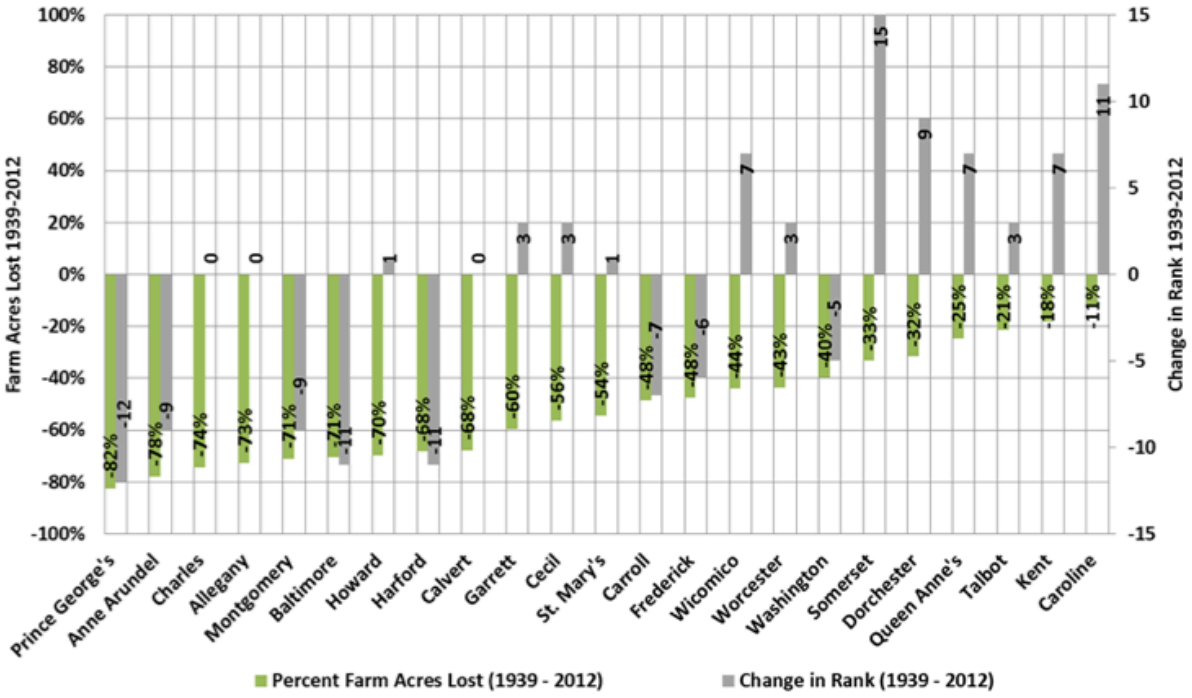
- Projected growth in population, households and jobs;
- The nature of development likely to take place to accommodate projected growth under existing local comprehensive plans, zoning maps and ordinances, water and sewer plans, and development regulations; and
- Market trends and patterns, as represented through geographic forecasts, extrapolation of recent trends, and proximity analysis.

The way in which these influences are represented in the analysis and used to estimate land use change as a result of growth is discussed in the *Methods* section. Potential effects of Growth Tier designation (a fairly recent state policy being implemented by local governments) as required by the Sustainable Growth and Agricultural Preservation Act of 2012; possible climate change impacts on land resources, specifically sea level rise and storm surge; and possible loss of agricultural land through BMP implementation under Maryland's Watershed Implementation Plan for the Chesapeake Bay TMDL, are also considered and estimated.

3.2 Growth, Development, and Impacts on Resource Lands and Industries

Before reviewing estimates of future resource land use changes due to development, climate change and BMP implementation, we review how land

Figure 3.2-1 Reduction in Farm Acres vs. Change in Economic Rank Maryland Counties, 1939–2012



Source: Census of Agriculture. Farms are defined as any place where $1000 or more of agricultural products are produced or sold. Economic rank is based on total sales of agricultural products.

use has changed in the past 75 years, what the effects may have been on agricultural and forestry industries, and what insights these relationships may provide to help interpret the effects of estimated future land use changes on industries.

3.2.1 Land Use and Resource Industries: Past Relationships

LAND USE AND AGRICULTURE: HISTORICAL RELATIONSHIP, CONTEXT FOR LAND USE IMPACTS

Figure 3.2-1 compares the reduction in farm acres with the change in agricultural economic rank for each county in Maryland from 1939 until 2012, as reported by the U.S. Census of Agriculture.*

The left Y Axis and the green bars show the percentage of farm acres present in 1939 that were lost by 2012. The right Y Axis and the grey bars show the change in a county's agricultural economic rank from 1939 to 2012, with rank defined by comparative total farm sales among counties.

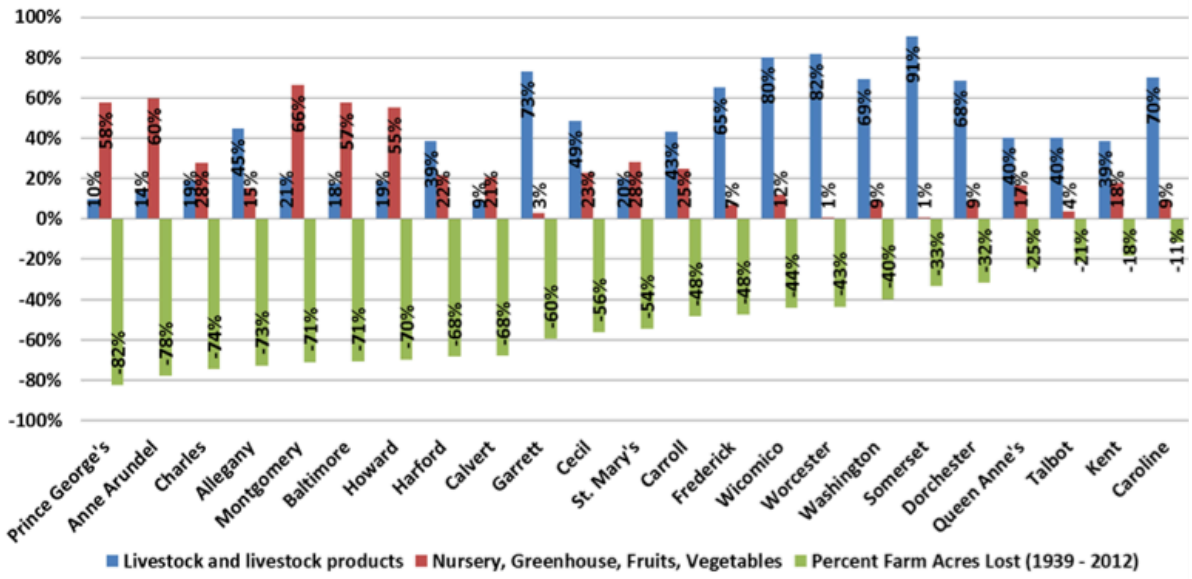
If a county had the highest total farm sales in 1939 (#1 rank), and ranked tenth in 2012, its change in rank shown on Figure 3.2-1 would be minus 9. Thus, counties with negative change in rank had lower total sales in 2012 compared to other counties than they did in 1939, while the opposite is true for those with positive change in ranking. Counties are presented along the X Axis from greatest to least percent reductions in farm acres.

These data suggest that, with a few exceptions (discussed below), counties that experienced greater reductions in farm acres tend to be those that experienced greater decreases in agricultural economic rank, a relationship one might logically expect to see.

Figure 3.2-2 shows the relationship between recent farm sales (as percentages of total sales in two categories, aggregated for the three most

* Note: reduced acres here do not necessarily mean developed acres. Acres in farms as reported in successive Agricultural Censuses simply reflect respondents' answers to questions about number of acres farmed.

Figure 3.2-2 Comparative Sales, Livestock Products vs. Nursery, Greenhouse, Fruits, & Vegetables Maryland Counties, 2002, 2007, & 2012



Source: 2002, 2007, & 2012 Census of Agriculture. Livestock & livestock products includes poultry, eggs, cattle, milk, dairy products, hogs, sheep, goats, horses, aquaculture, and other animals. Nursery, greenhouse, fruits, & vegetables includes vegetables, melons, potatoes, fruits, tree nuts, berries, nursery, greenhouse, floriculture, and sod. Percents are based on the total farm sales for the three census years.

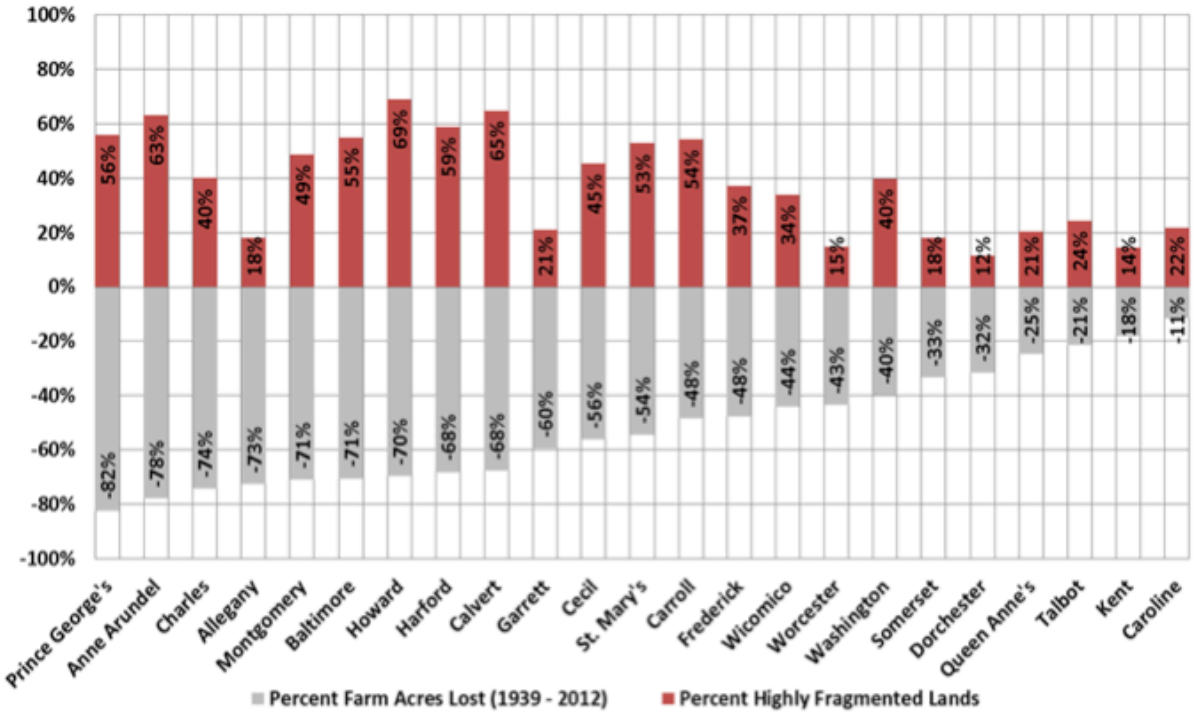
recent Agricultural Censuses) and reduction in farm acres. Ordering of counties along the X Axis is the same as in Figure 3.2-1. These data suggest that counties with smaller reductions in farm acres tend to have relatively higher percentages of total sales from livestock and livestock products in the period measured by the three most recent Censuses of Agriculture; those with greater reductions in farm acres tend to have relatively higher percentages of total sales from nursery, greenhouse, fruits and vegetables. Other sales are considered below.

Among the 12 counties that experienced a reduction of farm acres greater than 50 percent in Figure 3.2-2, two counties have percent sales from livestock that are much higher than the others. Garrett and Allegany counties, with 73 percent and 60 percent reductions in farm acres respectively, show livestock/ product sales two or more times those from nursery, greenhouse, fruits and vegetables (Garrett is more than 20 times) over the last three Agricultural Census periods.

These anomalous data for these two counties may result from a confluence of circumstances that sets them apart from others with comparable reductions in farm acres as measured by the historical census data. Specifically, the reported losses in farm acres may be due less to development—and more to conversion of former farmland to public conservation and uses other than residential development—than is the case in other counties. In Garrett County, three state forests (Potomac, Garrett and Savage River) collectively increased in size by over 53,000 acres since the late 1930s, as a result of state acquisitions and donations. Development in Garrett County, especially houses with extensive undeveloped cover types; golf courses; the Wisp resort; several large industrial parks on farmland; and extractive industries (surface mines for coal and rock) also probably account for considerable loss of farm acres as measured by the Census.* Western Maryland climate, rainfall, topography and geography support good production of quality forage (hay, grass for pasture) and eliminate the need to irrigate. Many dairies rely heavily or entirely on grazing. Beef markets have remained

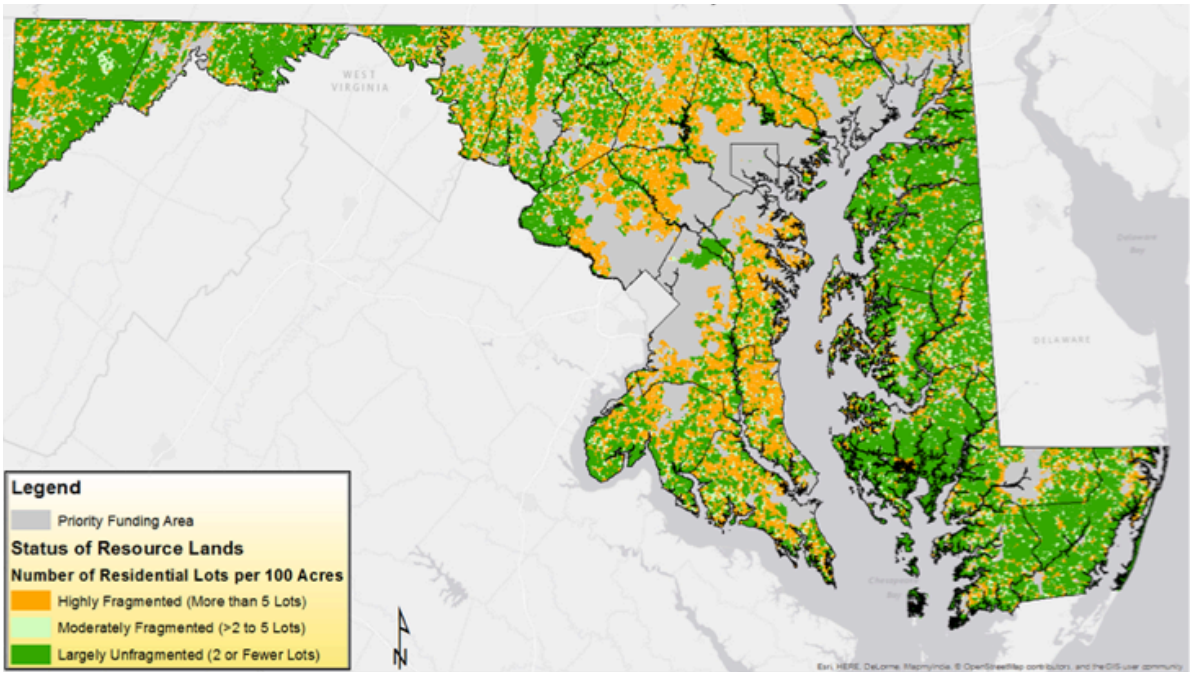
* Cheryl DeBerry, 2015, Personal Communication. Natural Resources Business Specialist, Garrett County, Maryland, Department of Economic Development.

Figure 3.2-3 Reduction in Farm Acres, 1939–2012 vs. Percent Highly Fragmented Lands, 2012 Maryland Counties



Source: Census of Agriculture & MDProperty View. Farms are defined as any place where $1000 or more of agricultural products are produced or sold. Economic rank is based on total sales of agricultural products.

Map 3.2-1 Residential Fragmentation of Rural Resource Lands, 2012



fairly strong, and in some areas significant Amish/Mennonite populations maintain extensive farmland acres in livestock. On the other hand, much of the farmland is not suitable for crops (slopes, soil structure, etc.) and is either managed as forests or pastures with some tree cover.*

Many of the phenomena at work in Garrett County may have a significant similar effect in Allegany County. This hypothesis is supported by the relative lack of fragmentation by residential development of rural lands in these two counties compared to others (Figure 3.2-3).

Figure 3.2-3 shows reduction in farm acres by county, as discussed above, compared to fragmentation of rural land by residential development. Fragmentation is a more direct measure of the degree to which residential development has fragmented and otherwise affected agricultural lands than is reduction in farm acres, and sheds additional light on its interpretation.

Fragmentation is the number of built, residential lots per 100 acres of rural land, which we measured by superimposing a 100-acre square grid on computerized tax maps of real property (parcels of land). Highly fragmented land has five or more built residential lots per 100 acres. Map 3.2-1 shows 2012 estimates of fragmentation statewide.

With the exception of Garrett and Allegany, counties with the larger reductions in farm acres (based on Agricultural Census data) tend to have larger percentages of highly fragmented land as of 2012. Garrett and Allegany counties have among the lowest percentages of highly fragmented land for Maryland counties in Figure 3.2-3. The reason is that, relatively speaking, there is not that much residential development diffused throughout their farmland. As discussed above, that finding is consistent with the idea that the large losses of farmland acres as measured by the census are due primarily to something other than development.

The point of the comparison is that, for purposes of interpreting and extrapolating to the future the apparent historic relationship between the Agricultural Census statistics on farm acres, sales and production emphasis (livestock versus nursery, etc.), it is important to distinguish effects of development versus other factors in that relationship.

The data reflect the notion that production of livestock and associated animal wastes, smells, noises and operational dynamics are relatively incompatible with substantial residential development and population, while the operational and environmental features of some other production options, including nursery, greenhouse, and fruits and vegetables, are somewhat more compatible.

The data also suggest that, in counties that experience the most conversion of farmland to development in the future, the emphasis in production and sales is likely to shift further from livestock toward nursery and greenhouse production, etc. This is not a good or bad thing, but is suggested as a likely eventuality by the historic data, which seems to corroborate the commonsense notion about livestock production and residential development.

However, the historic data may also suggest that farming can remain economically viable in landscapes that are relatively fragmented by residential development.

Among the first (left to right) nine counties in Figure 3.2-1—those with substantial reductions in farm acres—there are considerable differences in the magnitude of change in economic rank. Five of them— Prince George's, Anne Arundel, Baltimore, Montgomery and Harford—show reductions in rank comparable to the reductions in acres, i.e., both are large. Three of them—Charles, Howard and Calvert—show little or no change in rank. Allegany County has already been discussed as somewhat of an exception.

The differences in ranking changes between these two groups of counties suggest that there is more affecting economic rank, as measured

* Ibid

using Agricultural Census statistics, than the proportional amounts of livestock production and sales. No doubt year-to-year variation in external factors may play a role, making relative rankings in a given year somewhat anomalous; for example, geographic differences in rainfall might compromise production and sales of one commodity in a region in a given census year, and have little effect on another product in a different region. But examination of fragmentation data (Figure 3.2-3) in conjunction with sales data (see Figure 3.2-4*) suggests other factors that may also be at work.

Charles, Calvert and Howard counties have among the most fragmented rural landscapes in the state (Figure 3.2-3). Based on the 2012 Census, these three counties have essentially maintained their agricultural economic ranks since 1939. Figure 3.2-4 shows that only 9 percent (Calvert) and 19 percent (Howard and Charles) of their agricultural sales in 2007-2012 came from livestock products. Grains represent the largest percentage of farm sales in Charles and Calvert counties spanning the 2002 through 2012 period, while nursery products etc. held that distinction in Howard County. Between 6 and 10 percent of sales came from products other than livestock, nursery and grains in these counties during that recent period.

Thus, while more extensive conversion of farmland to development is likely to correlate with continued shifts away from livestock—at least traditional or conventional livestock—and possibly away from some production of crops for related reasons, it does not necessarily mean elimination of agricultural viability or income. Some kinds of farming may be economically sustainable enough to survive or thrive in landscapes fragmented by development, such as nursery/ greenhouse, fruits and vegetables, grains to some degree, and perhaps other emerging/ evolving markets that are less well established at present, such as growers who sell meat, fruit, vegetables and value-added products (like wine) to local, regional or national markets.

In Section 3.2.2, we will examine how much additional development might continue to influence changes in agricultural sectors.

LAND USE AND FORESTRY: HISTORICAL RELATIONSHIP, CONTEXT FOR LAND USE IMPACTS

How does development affect the forestry industry, and how might it affect it moving forward?

Tjaden et al† reported in 2015 that, of Maryland's 2.4 million acres of forestland, 75 percent, or roughly 1.8 million acres, is family owned; that there are presently 130,800 private forest landowners owning 78 percent of the forestland, with an average size holding of 17 acres; and that 75 percent of these landowners own less than 10 acres. In addition to the important role forests play in protecting most of Maryland's drinking water supply, Maryland's forest product industries include more than 1,300 manufacturing facilities, employ more than 10,000 Marylanders with an annual payroll of $650 million, generate tax revenues of $26 million annually from the sale of forest product goods and services, impact every county in Maryland, and are estimated to have a total economic benefit to the state of $4 billion and 40,000 jobs.

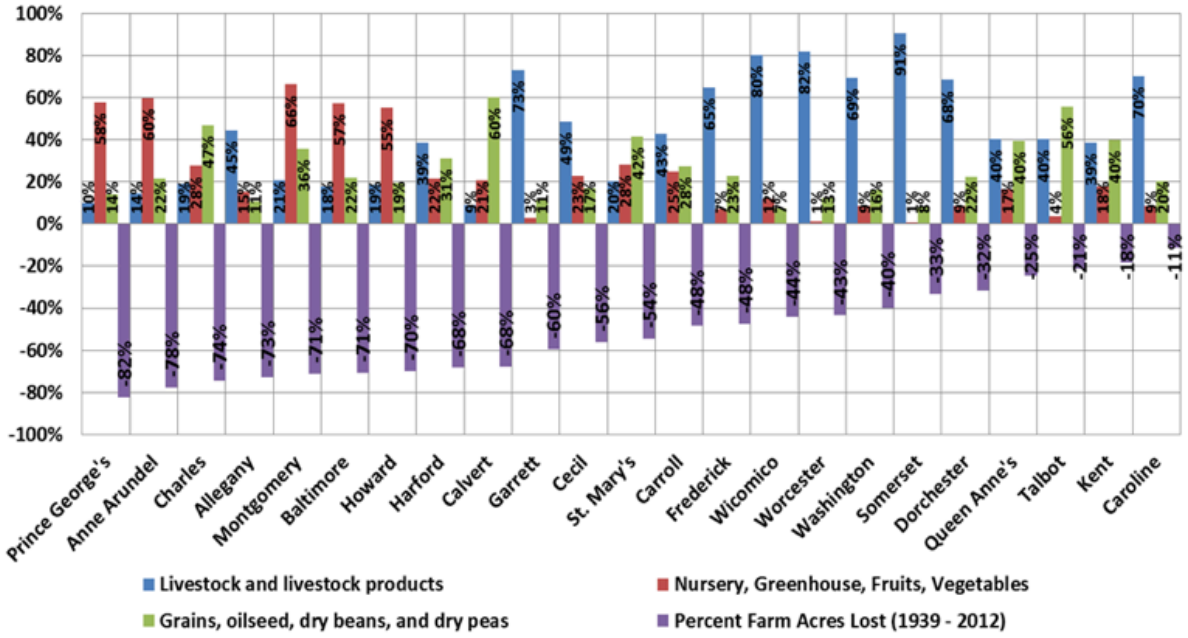
Three surveys conducted by Tjaden et al revealed that "Most [forest] landowners were located in Western Maryland (32 percent), with respondents also living in Eastern (26 percent), Central (20 percent), and Southern (19 percent) Maryland." For almost 60 percent of survey respondents, generation of income from timber products ranked as not very important. When asked to identify major barriers to their ability to maintain or expand their business, 11 of 23 responding forest industry owners and loggers rated availability of forestlands as *very* or *extremely important*.

In a 1998 study of the impact of urbanization on timber harvesting in southern states, Barlow et al found that, although good roads increased the likelihood of harvesting, "almost all measures

* Grains and other field crops is the major commodity category not incorporated in Figure 3.2-2, to avoid visually distracting from the livestock/nursery comparison. It is incorporated in Figure 3.2-4.

† Bob Tjaden, Dan Rider, Elliott Campbell and Amy Hudson, February 2015. *Maryland's Forest Resources in a Dynamic Environment: Assessing the Future Confidence and Sustainability of Maryland's Forest Industry.*

Figure 3.2-4 Comparative Sales: Livestock Products vs. Nursery, Greenhouse, Fruits, & Vegetables vs. Grains ¶ Percent Farm Acres Lost Maryland Counties, 2002, 2007, & 2012



Source: 2002, 2007, & 2012 Census of Agriculture. Livestock & livestock products includes poultry, eggs, cattle, milk, dairy products, hogs, sheep, goats, horses, aquaculture, and other animals. Nursery, greenhouse, fruits, & vegetables includes vegetables, melons, potatoes, fruits, tree nuts, berries, nursery, greenhouse, floriculture, and sod. Grains includes corn, wheat, soybeans, sorghum, barley, rice, other grains, oilseeds, dry beans, and dry peas. Percents are based on the total farm sales for the three census years.

of urbanization— but particularly proximity to development and higher population density—lead to lower harvesting rates."* The authors observed that encroachment of development into productive forested lands had substantial, diverse, direct and indirect impacts on harvesting. Direct land use conversion aside, they observed or cited references observing that:

- Timber management is curtailed on forest lands within driving distance of markets for land in metropolitan areas because these lands become more valuable for development than for timber;
- Conflicting views and values placed on forest lands between the forest industry and occupants of encroaching developed areas can result in harvesting and management regulations and restrictions that contradict profitable commercial forestry; and
- Forest fragmentation increases forest management costs.

Nowak et al† conclude that "many threats to forest sustainability are strongly connected to expanding urbanization" and forest fragmentation. These include fire at the wildland-urban interface, exotic pest infestations, and unmanaged outdoor recreation. To use pests as an example, urban areas and their interface with forests can act as portals of entry for exotic pests originating from international ports, usually located in or near urban areas. Movement of pests to forests is facilitated by unintentional transport to forested areas in the course of outdoor recreation or forestry-related activities. The pests have significant impacts on forest health and management. Several examples of exotic pests that have impacted U.S. forests are given.

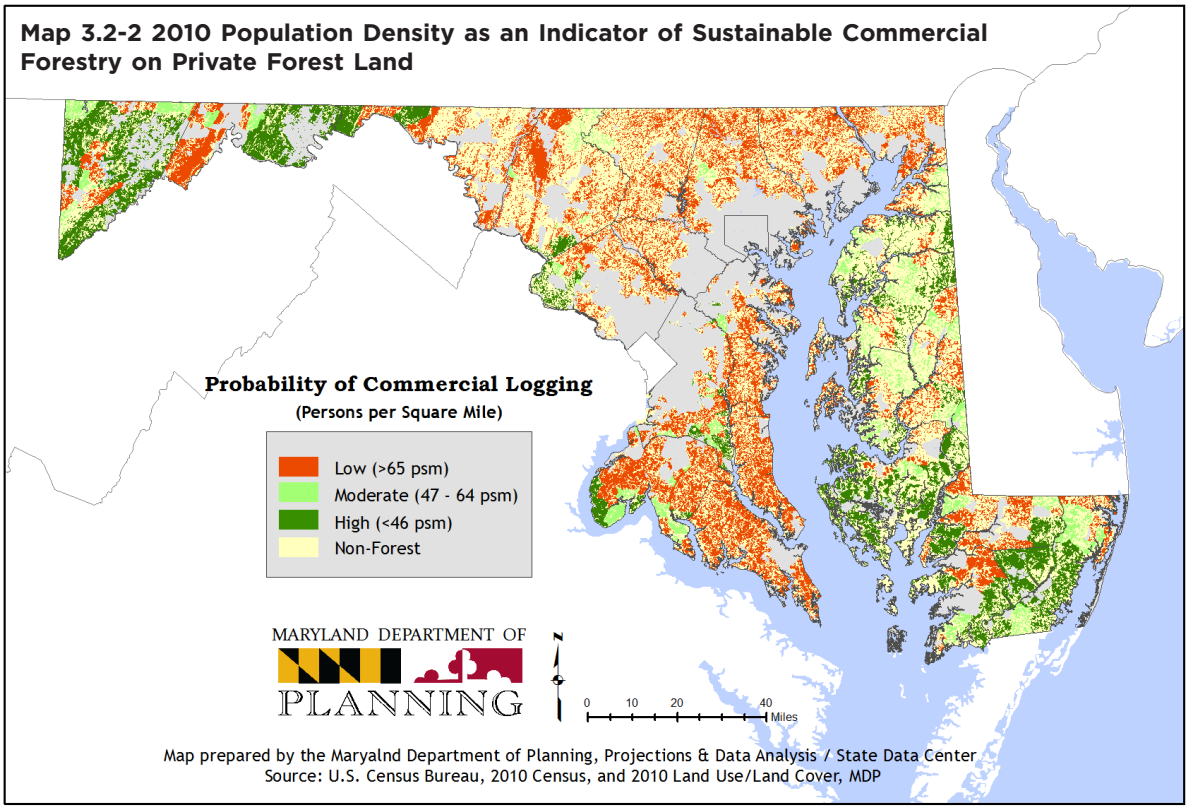
Wear et al tested the effects of expanding development and population on the likelihood of commercial harvesting of timber on private lands in Virginia's Piedmont.‡ They found that

* Barlow, Stephen A.; Munn, Ian A.; Cleaves, David A.; Evans, David L., 1998. *Journal of Forestry,* 96 (12), 10-14(5).

† David J. Nowak, Jeffrey T. Walton, John F. Dwyer, Latif G. Kaya, and Soojeong Myeong, 2005. *Journal of Forestry,* December 2005.

‡ David N. Wear, Rei Liub, J. Michael Foremanc, Raymond M. Sheffieldd, 1999. *Forest Ecology and Management* 118 (1999) 107-11.

Map 3.2-2 2010 Population Density as an Indicator of Sustainable Commercial Forestry on Private Forest Land



the probability of commercial forestry declines as population density increases, and approaches zero as density reaches 150 people per square mile.

In Wear's study, probability of sustainable commercial forestry was determined by expert opinions of foresters. The degree to which numerous factors, including population density, slope, site index and access category, explained logging probability was evaluated statistically, and only population density had a statistically significant relationship ($p = 0.05$).

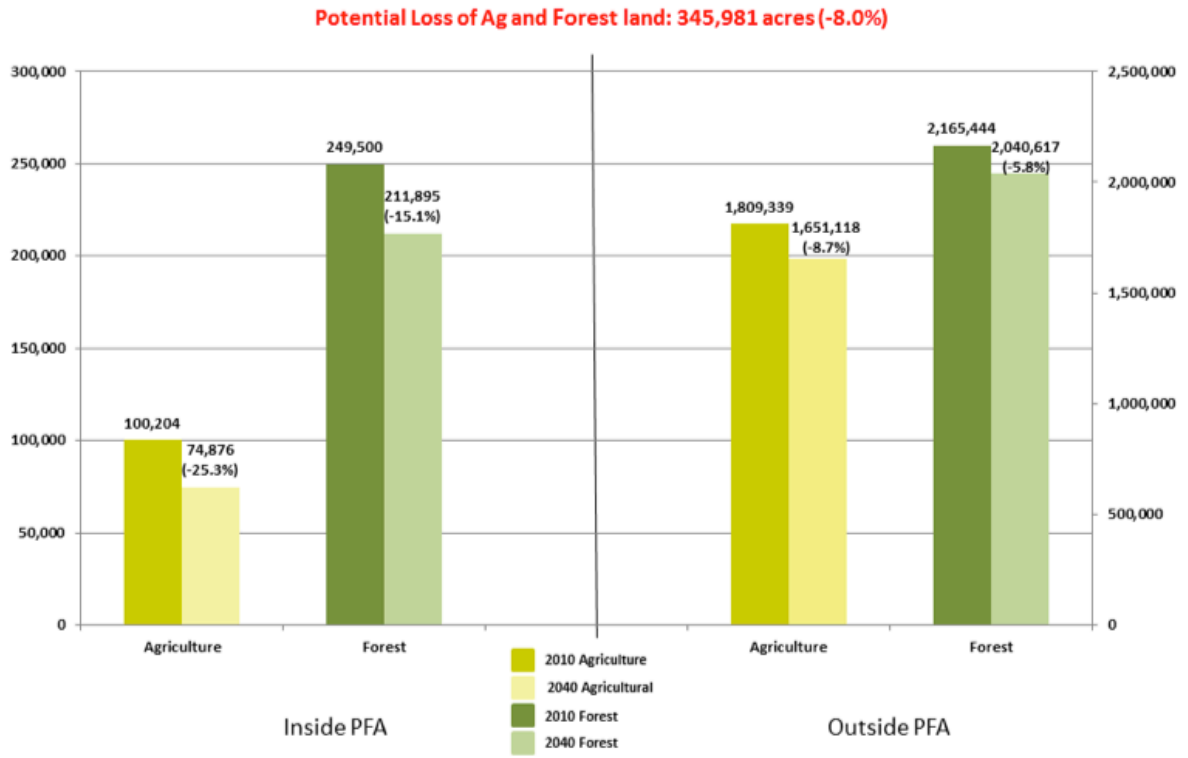
We adapted the quantitative relationships between population density and probability of commercial logging developed by Wear et al to Maryland's forestlands, and summarized the results in Map 3.2-2. We calculated population densities using 2010 Census Block data, aggregated by Block Group (in non-metropolitan counties) and by TAZ (in metropolitan counties), and overlaid the information with 2010 forested land cover in a geographic information system.

As applied to Maryland, it is not possible to say exactly how the metrics from Wear et al would relate to the perspectives of forest industry professionals and experts in Maryland, and therefore how they should be interpreted. For example, it is not possible to say that there is a near-zero chance that Maryland loggers would harvest timber in areas with population densities of more than 100 persons per square mile, although that was the case in Virginia's Piedmont. For this reason, the metrics from Wear's study can only be viewed as relative indicators when applied to Maryland.

In that light, Map 3.2-2* suggests that commercial logging is less likely to be sustainable on forestlands in Central and Southern Maryland (with a few scattered locales as exceptions) than on most of the Eastern Shore (except northern Cecil County and scattered parts of Wicomico and a few other counties), in Western Maryland (except Washington County), and in a few

* Priority Funding Areas (PFAs) for development and public forested lands outside PFAs are shown in white.

Figure 3.2-5 Estimated Acres of Agriculture and Forest, 2010 & 2040 State of Maryland



other scattered locales in Southern and Central Maryland. The issue for purposes of this project—how much more development will take place in these areas moving forward, and how will it affect forestry—is addressed in the next section of the report.

3.2.2 Estimated Land Use Change from Development

STATEWIDE AND BY REGION ESTIMATES

Figure 3.2-5 shows estimated future statewide changes in resource lands (agricultural and forest) between 2010 and 2040—an 8 percent decrease of roughly 346,000 acres.* Note that there are two Y axes—one for inside and one for outside Priority Funding Areas (discussed below), to enable changes at both scales to show in the same image.

Based on these statistics, it is estimated that about 82 percent of the future loss of resource land will occur outside Priority Funding Areas† (PFAs)—roughly 158,000 of the 184,000 acres of the future agricultural land loss estimate, and 125,000 of the 162,000 acres of forest. However, the losses of both land use/cover types in PFAs are not trivial—approximately 25,000 acres of agricultural and 38,000 acres of forested land.

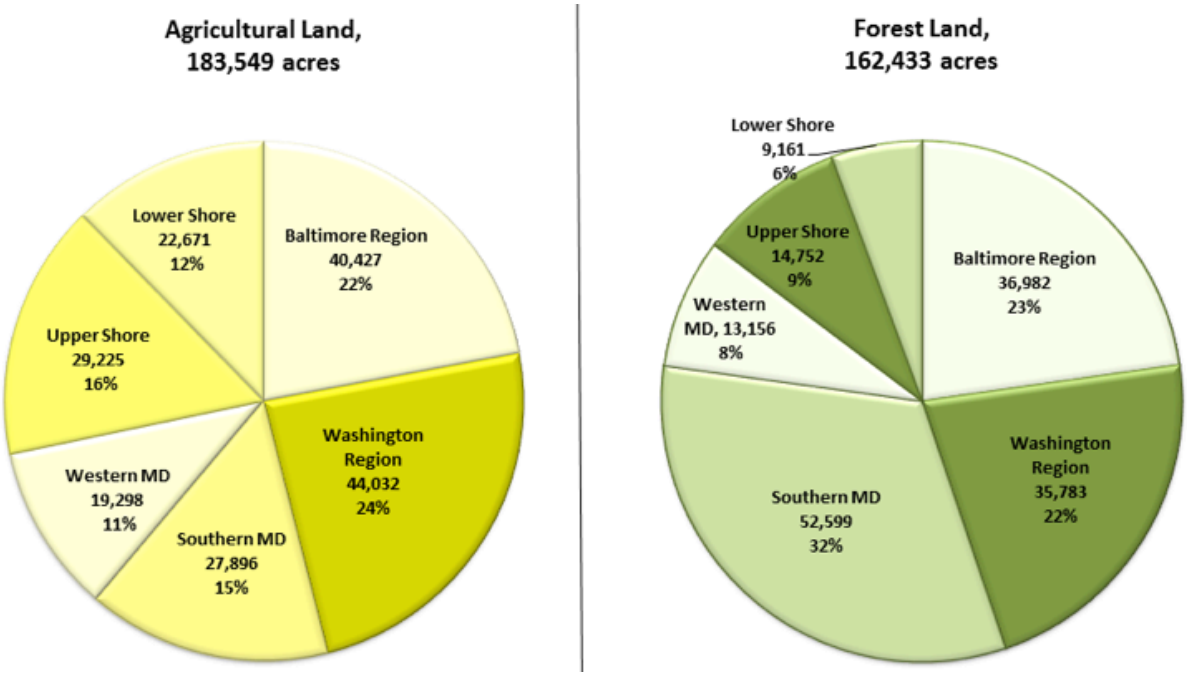
Figure 3.2-6 compares projected 2010-2040 losses of agricultural and forested lands among regions. For agricultural land, the largest losses are projected for the metropolitan Washington D.C. and Baltimore regions, followed by the Upper Eastern Shore, Southern Maryland, the Lower Eastern Shore and Western Maryland in that sequence. In the case of forest, Southern Maryland is projected to lose the most—42 percent more than the Baltimore region and 47 percent more

* Acres converted in these figures mean acres of residential lots subdivided and built on former resource land, at lot sizes (generally less than 5 acres) and densities (range from about 1 lot/ 5 acres to 1 lot/ 30 acres) typical for a given zoning district.

† PFAs as represented here are areas designated by local governments and recognized by the state as meeting the criteria for PFAs established in law.

Figure 3.2-6 Potential Loss of Agriculture and Forest Land, 2010–2040 State of Maryland

TOTAL LOSS OF AG AND FOREST LAND: 345,981 ACRES



than the Washington region. By comparison, losses in the Upper Eastern Shore and Western Maryland will be less than half those in the Washington D.C. region, while the Lower Shore will lose approximately 25 percent of the D.C. area estimate.

Comparing prospective losses of agricultural to forested land to each other within regions, both the Eastern Shore regions will lose roughly twice as many acres of agricultural land as they will forest. Western Maryland will lose 47 percent more acres of farmland than forest, the Washington D.C. region 23 percent more, and the Baltimore region 9 percent more. Southern Maryland is the only region in which more forest than agricultural land (89 percent more) will be lost.

IMPLICATIONS FOR INDUSTRIES AND EFFECTS OF SMART GROWTH TOOLS

One way to assess potential implications of these land use changes for agricultural and forestry industries is to consider them in context of what we know from past observations of the relationships among development, land use change and industry activity. These relationships were explored somewhat in the preceding section of this chapter: 3.2.1. For purposes of interpretation, it is useful here to review the implications for resource-based industries of fragmentation by development of rural lands.

To summarize, when rural landscapes are fragmented by large-lot residential development, integrity of many rural resources and types of agriculture and forestry are increasingly impaired. This occurs when the levels of development and associated human activities impact features of the landscape that support rural ecosystems and the ease and profitability of agricultural and forestry activities. This compromises farming and forestry in numerous ways. A few examples:

- Traffic interferes with movement of agricultural and forestry machinery, livestock and product between land used for production, processing, transport and distribution;
- Conflicts between farmers/foresters and residential occupants of the landscape affect

harvesting and processing requirements and practices, efficiencies and profitability associated with these activities, and can result in litigation;
- Reduced availability of and access to agricultural production supplies and processors, loggers, distributors and wholesale markets for agricultural and forest products reduce the profitability and feasibility of industry activities as a livelihood;
- Agricultural production tends to shift from livestock toward alternatives like nursery, greenhouse, fruits and vegetables; with some exceptions, agricultural sales tend to decline relative to areas not experiencing or experiencing less fragmentation;

The probability of commercial logging decreases.

To assess where effects of this sort may be greatest, it is useful to examine projected land use changes at a finer geographic scale; understand some of the reasons underlying variation in estimated changes from place to place; and consider historical relationships between production and land use as context for what may happen in the future.

Below are explanations of some of the data we use to examine possible implications of future land use change for resource industries: maps and graphics to show land use changes; information on zoning to help assess the roles of smart growth tools; and data on annual growth rates and growth in and outside PFAs to consider what may happen in context of what has happened. Subsequently, estimated land use change and their implications for agriculture are presented by region. Implications for forestry are then presented in a following separate section.

MAPS & GRAPHICS

Maps 3.2-3 through 3.2-8 show estimated numbers by region of new residential lots, 2010-2040, per 1,000 acres of underlying land outside PFAs. Results are shown at what we call the *small area* scale (see *Methods* section for more information) in our growth model, corresponding to Transportation Analysis Zones in metropolitan counties and Census Block Groups in other counties.

Areas estimated to experience relatively large amounts of residential development—corresponding to the red crosshatched areas on the maps *(50+ new households per 1,000 acres)*—are likely to experience the greatest impacts on agriculture and forestry. Impacts in the two lower intervals—*20-50 new households per 1,000 acres* (diagonal blue striping) and *1-20 new households per 1,000 acres* (horizontal black striping)—are likely to experience correspondingly lower impacts.

Although the intervals for 2010-2040 are in units (new households) per 1,000 acres, they correspond, quantitatively and qualitatively, to the units used on Map 3.2.1 for 2012 fragmentation. Thus, red crosshatching on the 2010-2040 maps means that those areas are likely to be highly fragmented, and their agricultural and forestry industries highly compromised in the ways mentioned above, by future development. Diagonal blue striped areas are likely to be moderately fragmented and compromised, and horizontal black striped areas to be least fragmented and compromised. It is also important to keep in mind that these estimated future impacts will be in addition to those that have already occurred as a result of existing development as of the year 2012, as shown on Map 3.2-1.

To supplement the information on the maps, Figures 3.2-7 to 3.2-12 compare projected 2010-2040 losses of agricultural and forested lands among counties within regions.

ZONING AS A SMART GROWTH TOOL

To help evaluate the significance of smart growth tools' possible influence on future losses of resource lands, in the following discussion of results we refer to three classes of rural zoning: most, moderately and least protective of land and resources. This classification is based on the number of residential lots typically subdivided in a given zoning district for a given acreage of land, which can also be called the yield: most protective (a yield of fewer than 1 lot per 20 acres of land),

Table 3.2-1 Residential Development, 1999-2012 (Actual) & 2010-2040 (Projected)

MARYLAND REGION	New Households/Yr by Region Number (& % of State Total)		% New Households in PFAs		% Developed Acres outside PFAs*	
	1999-2012†	2010-2040‡	1999-2012§	2010-2040**	1999-2012	2010-2040
Central MD	6,377 (37%)	5,497 (33%)	78%	79%	74%	75%
Capital Region	5,352 (31%)	6,438 (38%)	81%	78%	63%	74%
Southern MD	2,093 (12%)	2,138 (13%)	51%	46%	88%	88%
Upper Eastern Shore	1,310 (8%)	1,181 (7%)	57%	47%	83%	85%
Lower Eastern Shore	1,144 (7%)	788 (5%)	60%	42%	78%	89%
Western MD	899 (5%)	732 (4%)	47%	48%	86%	88%
Statewide	17,176 (100%)	16,773 (100%)	71%	68%	77%	81%

* (Acres of developed single family residential parcels outside PFAs)/(acres of developed single family residential parcels inside and outside PFAs).
† New built single family detached and attached residential units and condominiums, not apartments.
‡ Forecast New Households.
§ Percent of new built single family detached and attached residential units and condominiums, not apartments
** Forecast New Households as distributed by MDP's growth model.

moderately protective (1 lot per 10 to 20 acres) or least protective (1 lot per less than 10 acres). Zoning is a particularly important smart growth tool for purposes of this project, because it is the nexus for state smart growth policies, local comprehensive plans, water and sewer plans, and development and related environmental regulations.

GROWTH IN AND OUTSIDE PFAS

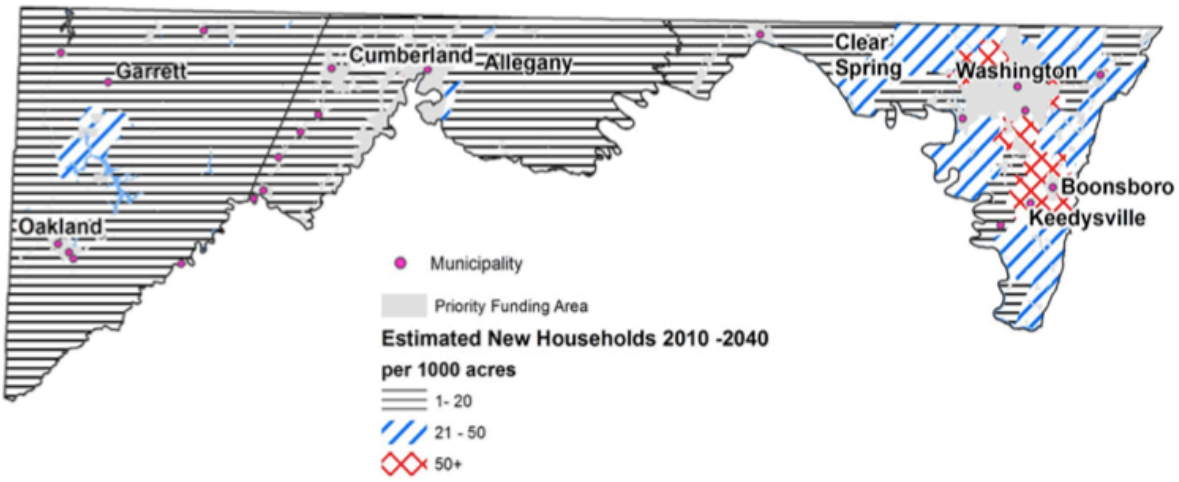
Accordingly, we use it to assess the degree to which these tools may or may not help sustain resource-based industries through their effects on land use change.

Table 3.2-1 compares three parameters by region and statewide for a recent period of time, 1999-2012, and the future period for which we are estimating change, 2010-2040: *annual growth rates* (estimated numbers of new households per year); *percent new households in PFAs*; and *per cent residential acres developed outside PFAs*. The 1999-2012 data is essentially empirical, derived from real property tax data. The 2010 to 2040 data is estimated using the sources and modeling procedures discussed in some detail in the *Methods* section of this chapter.

Most new residential and commercial development occurs within PFAs. The average new unit of development outside PFAs consumes more resource land than the average unit developed inside PFAs. This is due to numerous factors, not the least of which is the fact that residential lots outside PFAs must be large enough to accommodate reserve drain fields for on-site sewage disposal.

This in large part explains the somewhat counter-intuitive fact that higher percentages of new growth (measured as the number of new households) occur in PFAs, while higher percentages of developed acres occur outside PFAs. This is not a new phenomenon, as

Map 3.2-3 Estimated Residential Development Outside PFAs, 2010–2040, Western Maryland



illustrated by its occurrence in the 1999-2012 time period (statewide, 71 percent of new households in PFAs, 77 percent of new developed acres outside PFAs).

IMPLICATIONS: WESTERN MARYLAND

In Western Maryland (Map 3.2-3), areas estimated to be moderately (*20-50 new households per 1,000 acres*) and highly (*50+ new households*) fragmented by new development in the next 25 years are concentrated in Washington County, around Hagerstown and south to Boonsboro, Keedysville, and the South Mountain area, and in Garrett County to an area around Deep Creek Lake. These areas were already relatively highly fragmented as of 2012 (see Map 3.2-1). Much of the land comprising these areas is highly vulnerable to additional development under current zoning.

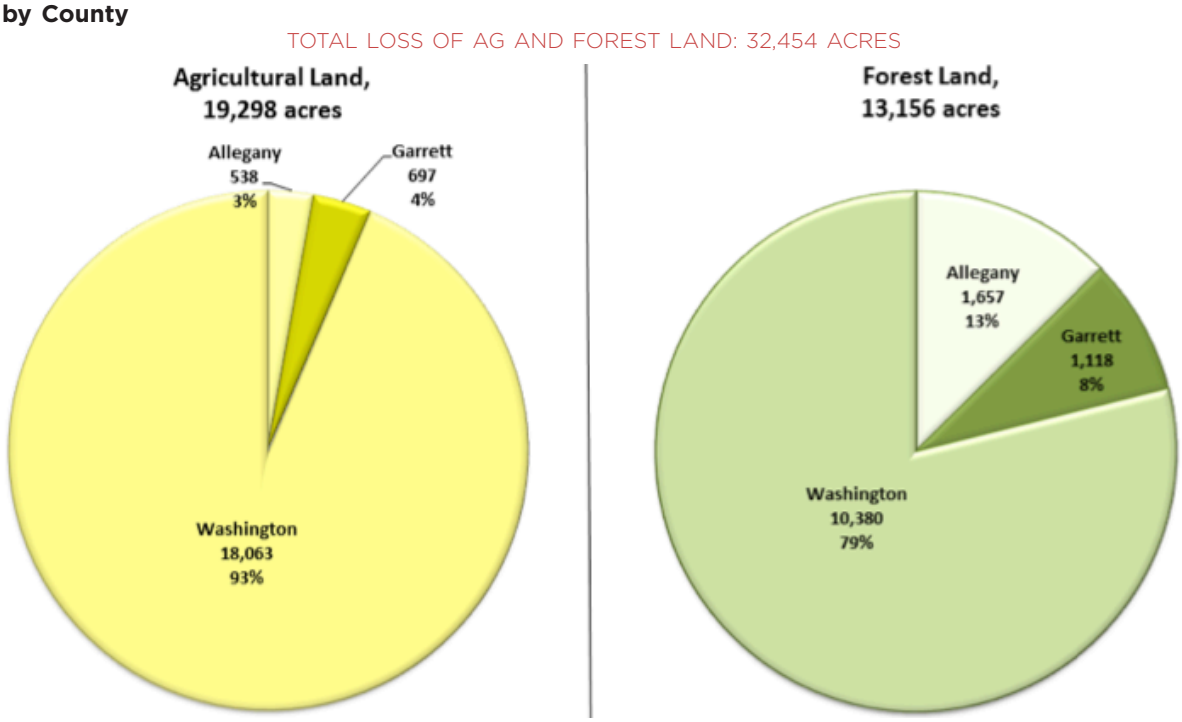
The area around Hagerstown is of considerable importance to Western Maryland's agricultural industry. With the exception of the aforementioned area near Deep Creek Lake, most of the rest of Western Maryland is likely to be relatively unfragmented (*less than 20 new households per 1,000 acres*) by new growth.

Figure 3.2-7 compares losses of agricultural and forest resource lands among Western Maryland counties. Washington County dominates statistics for both types of land.

From 2010 to 2040, Washington County is projected to grow by roughly 18,000 households, Garrett and Allegany by approximately 1,500 each. Clearly the magnitude of projected growth explains much about the estimated distribution of growth impacts among counties. For the region as a whole, annual growth rates, percentages of new residential parcels built inside PFAs, and percentages of corresponding developed acres built outside PFAs are estimated to be roughly equal to those observed for the period 1999-2012 (Table 3.2-1). Both Washington and Allegany counties have considerable extents of moderately protective rural zoning, so that should not account for much difference between the two at the county scale. Within Washington County, however, the zoning around much of Hagerstown and extending southeast to Boonsboro is least protective, coinciding with the areas likely to be most heavily affected. As noted above, the area is highly vulnerable to additional subdivision and development, both by virtue of its location relative to markets emanating from Hagerstown and other employment centers to the east, and by virtue of its relatively permissive zoning.

Washington, Allegany and Garrett counties have among the highest percentages of their agricultural sales in livestock and related products, much of it dairy which, based on our review of historic relationships between land use and industry changes, stand a good chance of being

Figure 3.2-7 Potential Loss of Agriculture and Forest Land, 2010–2040 Western Maryland by County



Map 3.2-4 Estimated Residential Development Outside PFAs, 2010–2040, Baltimore Region MD

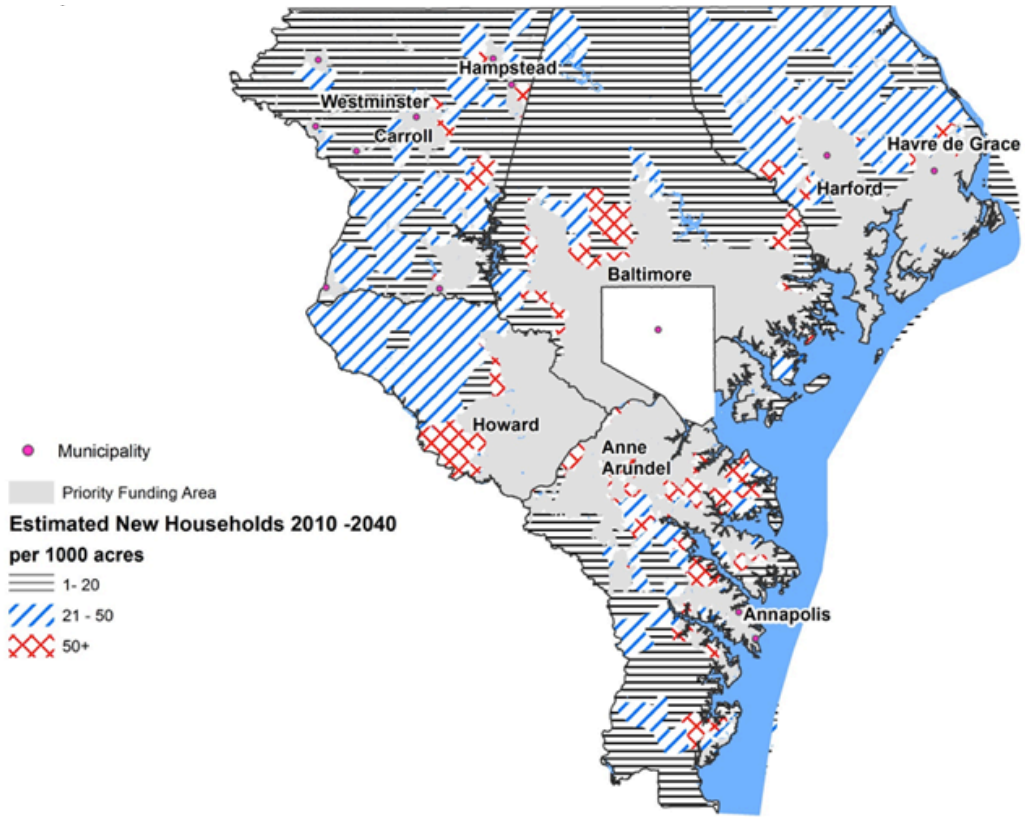
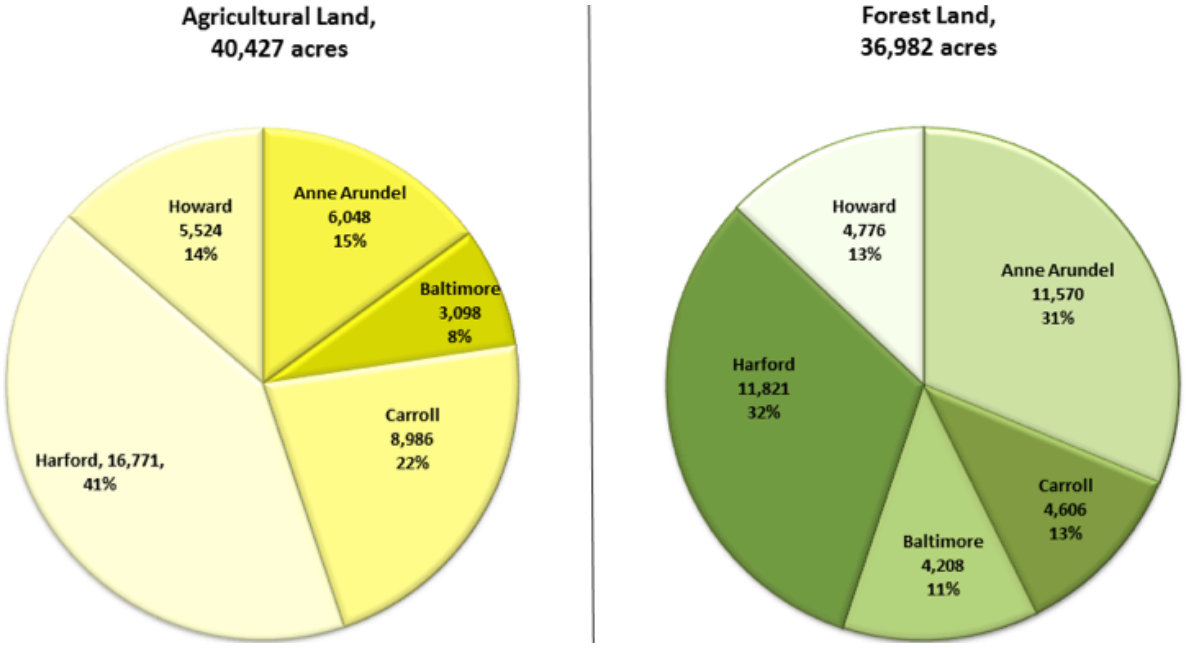


Figure 3.2-8 Potential Loss of Agriculture and Forest Land, 2010–2040 Baltimore Region by County

TOTAL LOSS OF AG AND FOREST LAND: 77,409 ACRES



negatively affected by the amount and extent of impacts projected in Washington County. Those industries may decline.

IMPLICATIONS: BALTIMORE (CENTRAL MARYLAND) REGION

Figure 3.2-8 compares estimated future losses of agricultural and forest resource lands among counties in the Baltimore metropolitan region. The estimated geographic distribution of those losses is seen on Map 3.2-4. On the map, some areas in all five counties will experience highly or moderately fragmenting levels of development by 2040, over and above existing fragmentation. By acreage, Harford County stands to lose the most of both agricultural and forest land. The smaller acreage losses in Howard County are focused within a relatively small geographic area, so the projected impacts per 1,000 acres (seen on the map) are comparable to those in Harford County. In essence, the mapped impacts (per

1,000 acres) account for differences in the size of counties not reflected by the comparative statistics shown in the pie charts alone. Using the map as a guide, impacts in this region will be most extensive in Howard and Harford counties, least extensive in Baltimore, and somewhat intermediate in Carroll and Anne Arundel counties.

Anne Arundel (*45,000 new households projected*), Baltimore (*40,000 new households*) and Howard (*40,000 new households*) are expected to see substantially more demand for residential development than Harford (*23,000 new households*) and Carroll (*12,000 new households*) counties. In all of these counties, the majority of new residences will be within sewered Priority Funding Areas (PFAs), but those occurring outside PFAs will be substantial enough to cause these levels of estimated impacts. The annual growth rate for the region as a whole will be almost 1,000 new households lower from 2010-2040 than it was for the 1999-2012 periods, but the percentage of new households built inside PFAs and the percentage of developed acres built outside PFAs are estimated to be roughly equal for the two periods (Table 3.2-1).

Baltimore County tends to have the most protective rural zoning in this region speaking generally, Howard and Harford the least protective, and Carroll and Anne Arundel counties moderately protective.

Within Baltimore County, the largest area of estimated high future impacts on Map 3.2-4 (*50+ new households per 1,000 acres*) corresponds to an area with moderately protective rural zoning (the area between the I-83 and I-795 corridors, extending north and northwest from the core urban area around Baltimore City). This area is already highly fragmented by residential development as of 2012 compared to most of rural Baltimore County. Similarly, within Carroll County, the more significant impacts can be expected in south Carroll and the area between Westminster and Hampstead, corresponding to current locations with the least protective zoning and more highly fragmented resource lands in the county. As in other regions, zoning explains much about the variations in loss patterns both within and among counties.

Of the Central Maryland counties, Harford and Carroll have the largest percentages of sales from livestock and related products. As noted, the greatest impacts in Carroll are projected for the more developed/ less intensively farmed parts of the county, but impacts in Harford County seem likely to be more uniformly widespread. That may be where the greatest effects on the industry occur in this region.

A final point of interest about estimated future development in the Baltimore region is that potential effects of the Septics Bill—the Sustainable Growth and Agricultural Preservation Act of 2012—and limitations in our ability to estimate redevelopment and infill in some instances are illustrated in the findings. See sections 3.4.8 and 3.4.11 in the *Methods* section for details.

In summary, under existing zoning, much of the land in these counties is nearing build out—that is, it can't be extensively further subdivided and developed under the limits imposed by zoning. In Tier IV areas in particular, restrictions on major subdivisions reduce capacity for residential lots even further in western Howard and much of rural Harford County. As discussed in the *Methods* section of this Chapter, these lower limits contribute to greater dispersion of the impacts of residential development shown on Map 3.2-4 (*20 to 50 new households per 1,000 acres*), over a wider area than might occur in the absence of Tier IV restrictions.

Also as discussed in the *Methods* section of this Chapter, underestimation of infill and redevelopment capacity in growth areas can also contribute to over-estimation of growth in rural areas. This is particularly true in counties with limited development capacity in growth areas, and it may therefore occur to some degree in Howard and Harford counties. Without additional data on redevelopment capacity in excess of what could occur under existing zoning, however, it is not possible to estimate in an analysis of this scale.

IMPLICATIONS: UPPER EASTERN SHORE

On the Upper Eastern Shore (Map 3.2-5), the most extensive areas estimated to be highly impacted by growth (*50+ new households per 1,000 acres*) are in northern Cecil County and the southern portion of Kent Island. Northern Cecil County supports agriculture and forestry, but both areas were already fairly fragmented by residential lots as of 2012. Extensive additional moderate impacts are estimated in parts of Queen Anne's (south of Centreville) and Caroline (north, east and southwest of Denton) counties. Cecil and Caroline have the largest shares of their agricultural sales from livestock and related products within the region. To the degree that these industry sectors occur in the parts of those counties projected to experience the most significant impacts, their sustainability and vitality may be compromised by incompatible residential development.

Areas with most protective zoning in Kent, Caroline and southern Cecil counties are estimated to suffer relatively little damage, assuming zoning and local land use and conservation policies remain intact. Of these areas, only northern Cecil was noticeably highly fragmented as of 2012. Maryland Route 404 extends through the area between Denton and Centerville marked as moderately impacted (*21 to 50 new households per 1,000 acres*) from 2010-2040. Route 404 improvements are making this area increasingly attractive and accessible for subdivision, Caroline County's relatively

Map 3.2-5 Estimated Residential Development Outside PFAs, 2010–2040, Upper Eastern Shore MD

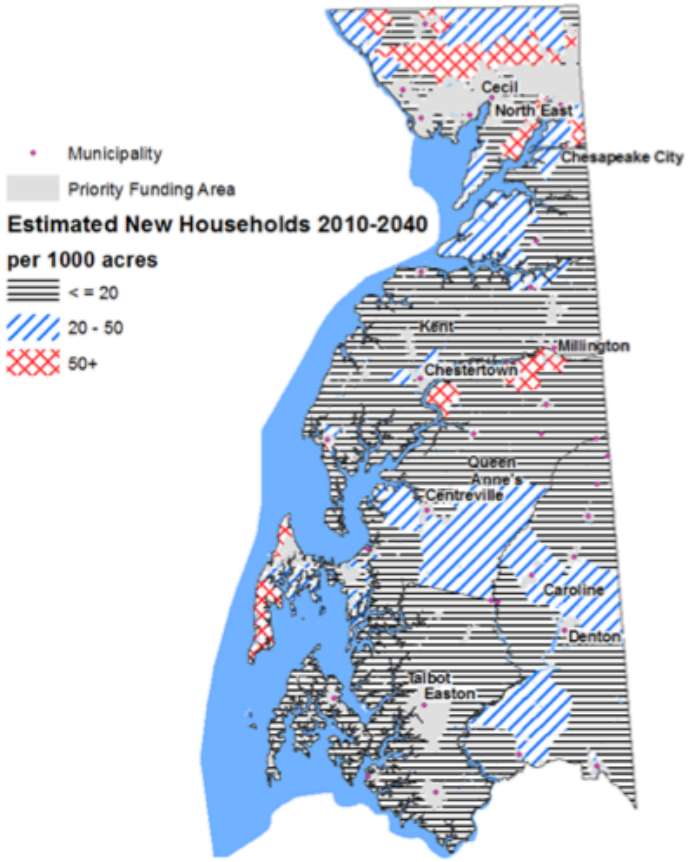


Figure 3.2-9 Potential Loss of Agriculture and Forest Land, 2010–2040 Upper Eastern Shore Region by County

TOTAL LOSS OF AG AND FOREST LAND: 43,977 ACRES

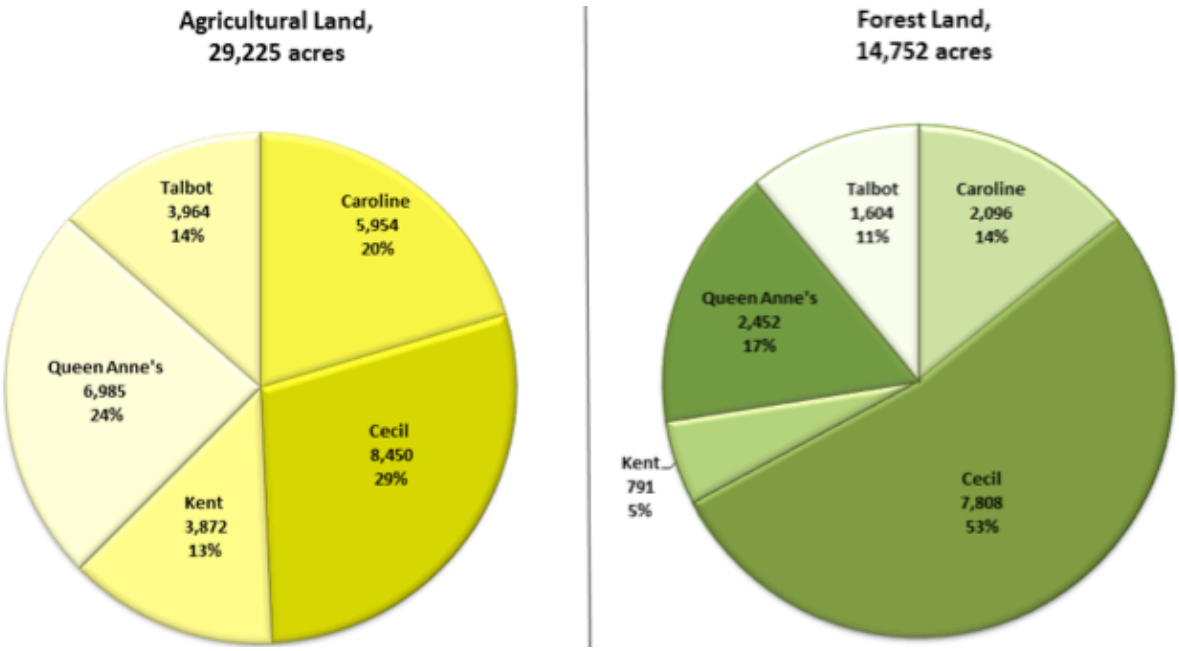


Table 3.2-2 Projected New Household Demand 2010–2040 Upper Eastern Shore Region

County	Projected New Households
Cecil County	16,000
Kent County	2,500
Queen Anne's County	8,300
Talbot County	3,650
Caroline County	5,000

protective zoning notwithstanding. The 2010-2040 projected annual growth rate for the region as a whole will be similar to that observed for the 1999-2012 period (Table 3.2-1). The percentage of new households built inside PFAs is projected to decline by 10 percentage points—the second largest decrease estimated for any region. However, the percentage of developed acres built outside PFAs is only estimated to increase slightly over the 2010-2040 period, by two percentage points, perhaps indicating smaller average size lots than during the earlier period.

IMPLICATIONS: METROPOLITAN D.C. (CAPITAL) REGION

Shifting to the D.C. metropolitan area, rural resource lands in Frederick (*41,300 projected new households by 2040*), Montgomery (*103,500 new households*) and Prince George's (*58,400 new households*) counties will all be impacted by substantial growth (Map 3.2-6). The areas shown as likely to experience moderate (*21 to 50*) to high (*50+*) increases in households per 1,000 acres include considerable lands zoned for low and very low density residential use in all three counties, as well as some lands with moderately and least protective resource zoning in parts of Frederick and Prince George's counties. There are extensive areas in all three counties estimated to experience relatively limited growth as well (*1-20 new households per 1,000 acres*), generally corresponding to most protective zoning.

Map 3.2-6 Estimated Residential Development Outside PFAs, 2010–2040, Washington Region MD

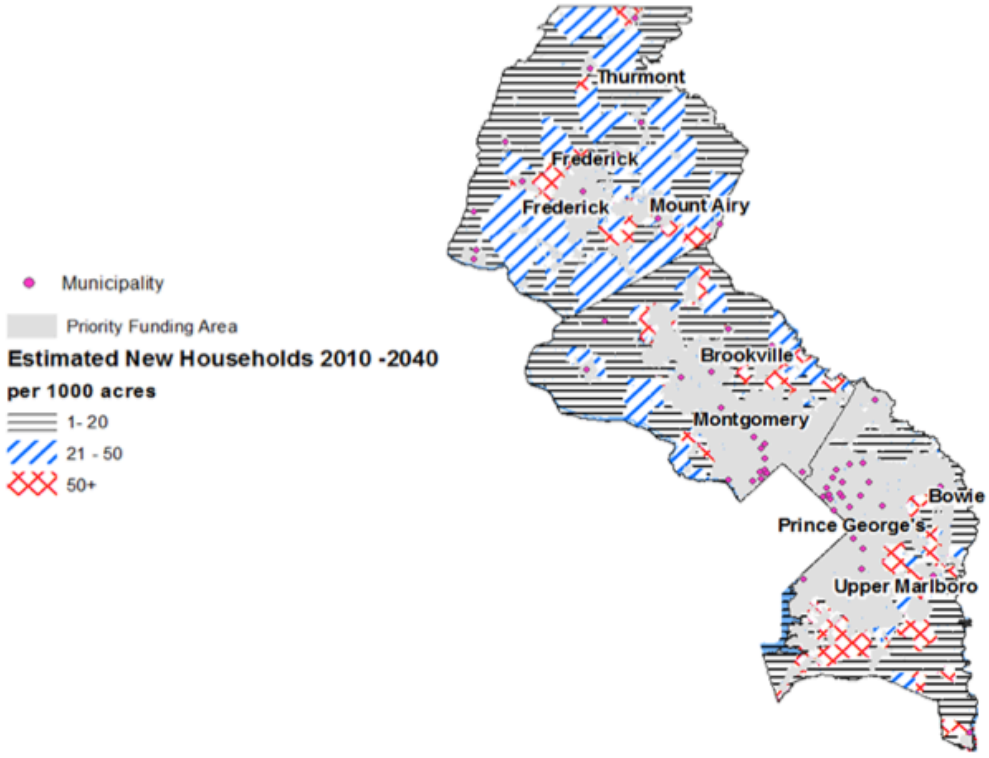


Figure 3.2-10 Potential Loss of Agriculture and Forest Land, 2010–2040 Washington Region by County

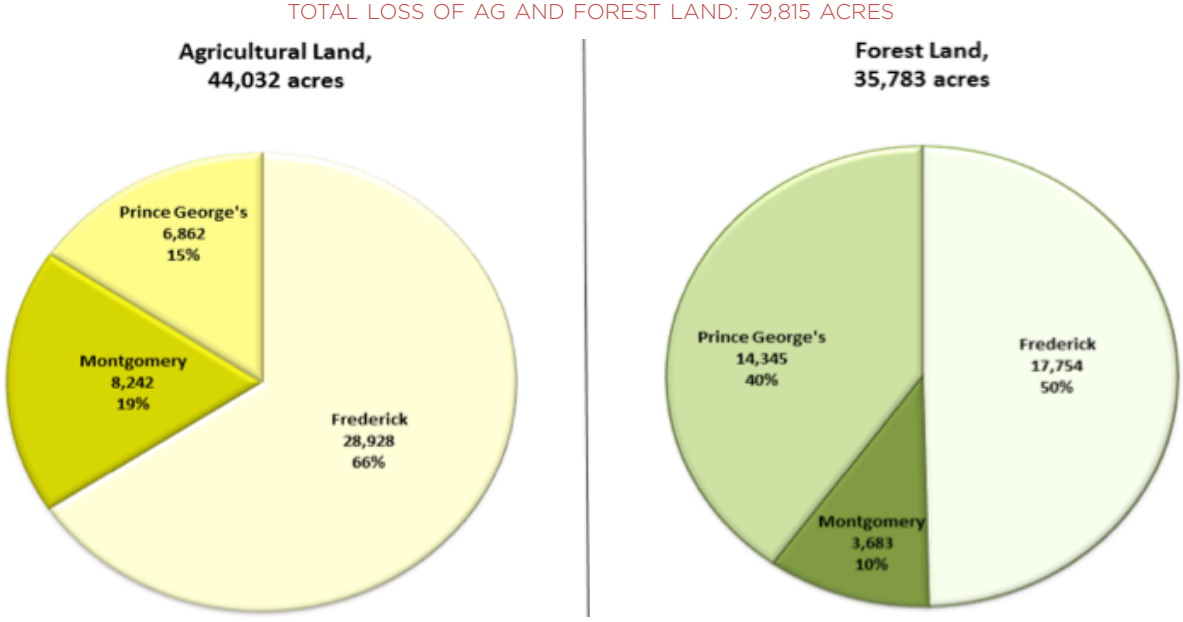


Figure 3.2-10 compares estimated acreage losses of resource lands by county in the region. Losses will be far greater in Frederick and Prince George's than in Montgomery County. The annual growth rate for the region as a whole (Table 3.2-1) will be roughly 1,100 new households higher than that observed for the 1999-2012 period. Seventy-eight percent of new households will be built inside PFAs, while 74 percent of developed residential acres will be built outside PFAs—at 11 percentage points higher, the second largest increase by region from the earlier period—suggesting that more of the rural residential dwellings in this region will be built on larger lots, perhaps in more rural and restrictive zoning districts, than has occurred previously.

Livestock industries have the greatest presence in Frederick County within this region, and based on this analysis, will be the most threatened by compromising impacts of development. Agricultural sales in Prince George's and Montgomery counties have been dominated, relatively speaking, by nursery, greenhouse, fruits and vegetables over the last three Agricultural Censuses, with significant remaining presence of livestock products as well as grains, oilseed, beans and peas in Montgomery.

IMPLICATIONS: SOUTHERN MARYLAND

In Southern Maryland, acres of resource land lost (Figure 3.2-11) in Charles (*32,000 new households projected*) and Saint Mary's (*25,000 new households*) counties are estimated to be almost three times those in Calvert County (*7,000 new households*). Areas estimated to experience the highest impacts per 1,000 acres (Map 3.2-7) are more extensive in Charles and Saint Mary's. For the region, this is the result of 46 percent of projected new households locating outside PFAs—moderately less than the 51 percent that did so from 1999-2012—and accounting for 88 percent of the residential acres developed during both periods (Table 3.2-1). Rural zoning in Charles County is least protective, moderately more protective in Saint Mary's, and a combination of moderately and least protective in Calvert County. The annual growth rate for the region as a whole (Table 3.2-1) will be marginally greater than that observed for the 1999-2012 period. Grains, oilseeds and dry beans hold the greatest share of agricultural sales in all three of these Southern Maryland counties over the last three Agricultural

Map 3.2-7 Estimated Residential Development Outside PFAs, 2010–2040, Southern MD

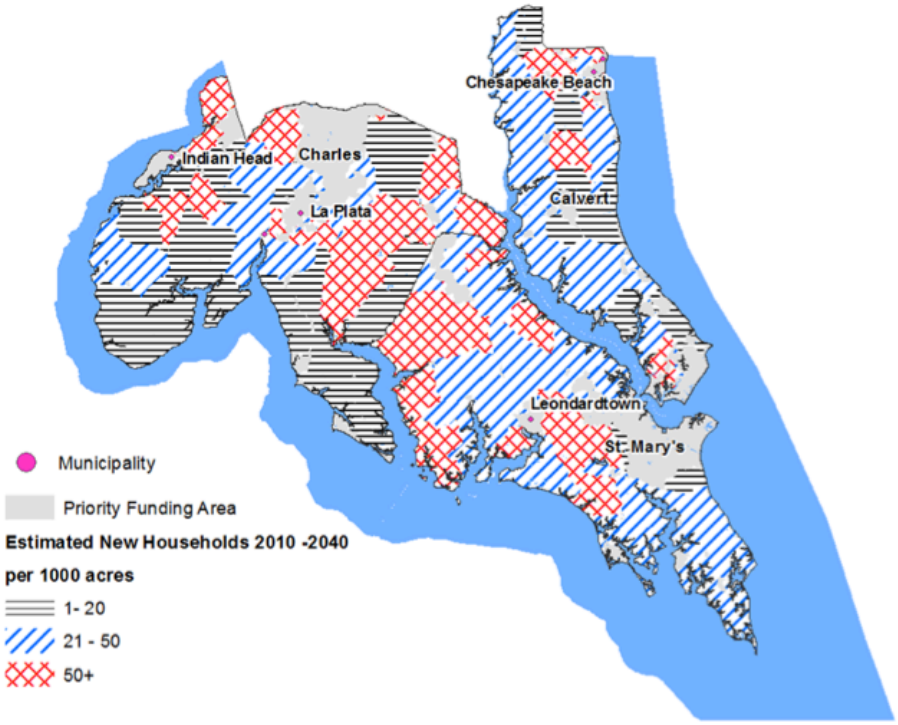
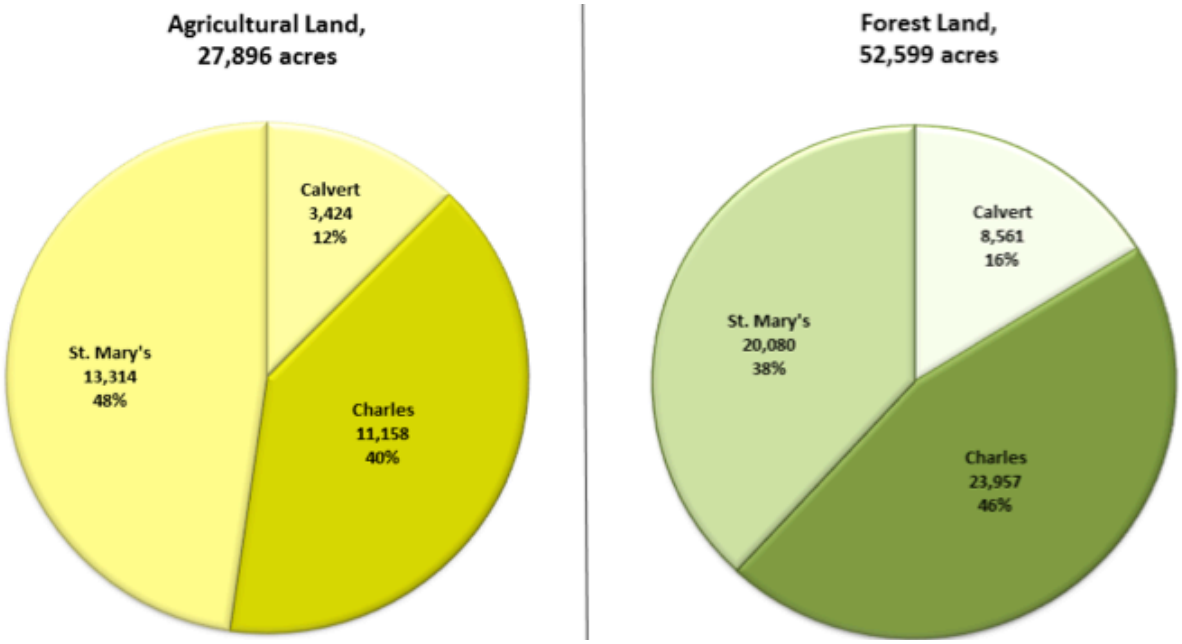
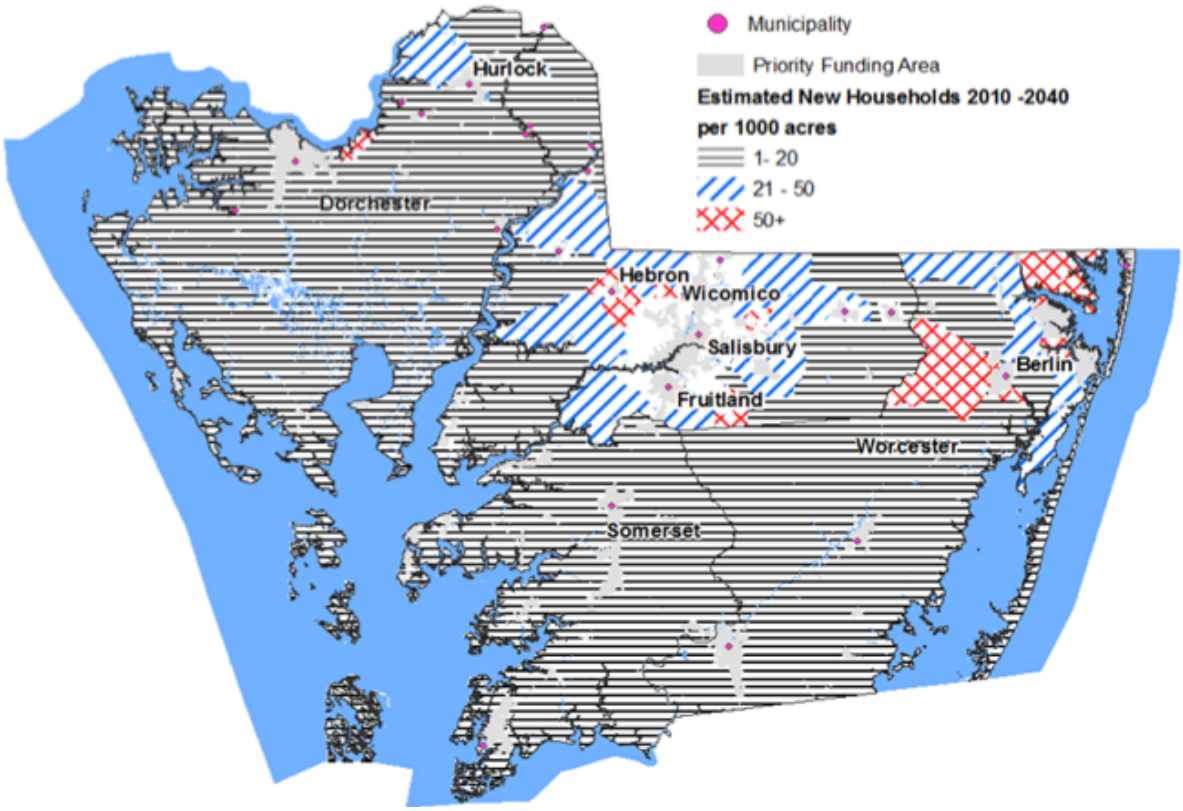


Figure 3.2-11 Potential Loss of Agriculture and Forest Land, 2010–2040 Southern Maryland by County

TOTAL LOSS OF AG AND FOREST LAND: 80,495 ACRES



Map 3.2-8 Estimated Residential Development Outside PFAs, 2010–2040, Lower Eastern Shore MD



Censuses. Based on this land use analysis, these industries could be compromised throughout the region, particularly where they are of large scales perhaps more prone to conflicts with occupants of extensive residential development.

IMPLICATIONS: LOWER EASTERN SHORE

On Maryland's Lower Eastern Shore, losses of resource land will be greatest (Figure 3.2-12) in Wicomico County, projected to grow by another 12,500 new households, followed by Worcester (*6,500 new households*), Dorchester (*4,000*) and Somerset (*900*) counties in that order. As shown on Map 3.2-8, the greatest and most extensive losses per 1,000 acres are projected to occur in areas radiating in all directions from Salisbury in Wicomico County, and north and west of Berlin in Worcester County. In both cases much of the affected land is zoned for low and very low density residential development; in Wicomico, considerable portions have the least protective resource conservation zoning.

The Lower Shore is expected to see a significant decline in annual growth which, from 1999-2012, was already second lowest in the state (Table 3.2-1); a significant decrease in percent new residences inside PFAs, from 60 percent for 1999-2012 to 42 percent from 2010-2040; and, a significant increase in percent residential developed acres outside PFAs, from 78 percent in the earlier period to 89 percent during the future period.

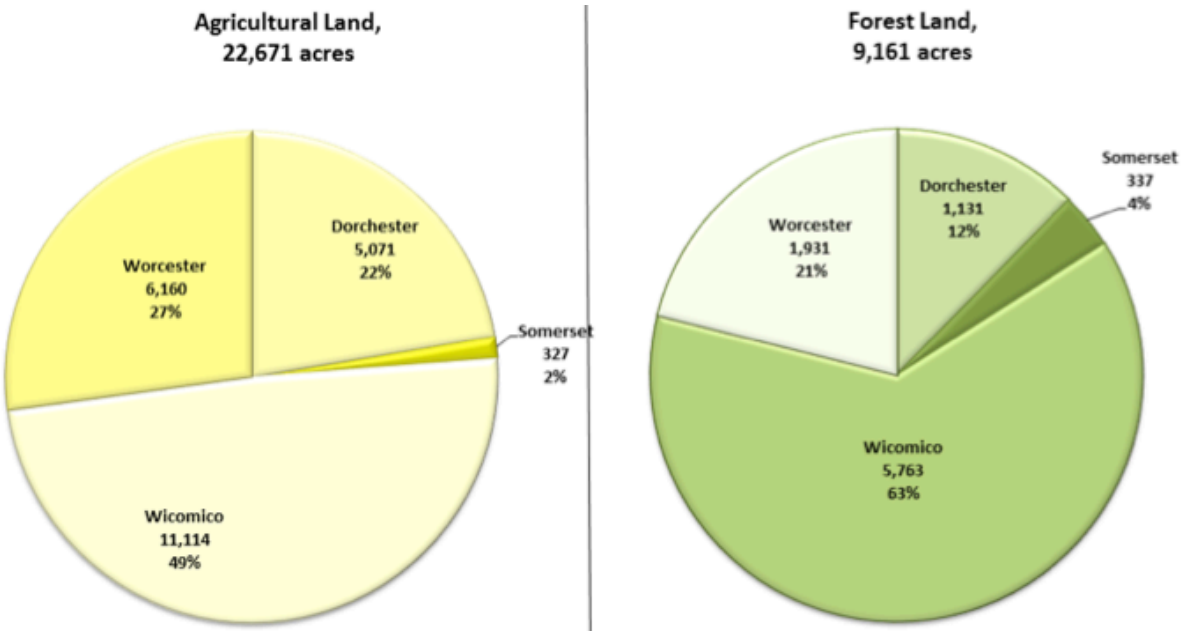
The biggest threat here from residential population and related land use impacts is obviously to the poultry industry in Wicomico County, and perhaps to feed production, although only 7 percent of Wicomico County's agricultural sales in the last three Agricultural Censuses came from grains, oilseed, beans and peas.

IMPLICATIONS: FORESTRY INDUSTRIES

To identify locales where estimated future development is projected at a level more likely to impact the probability of commercial logging,

Figure 3.2-11 Potential Loss of Agriculture and Forest Land, 2010–2040 Lower Eastern Shore Region by County

TOTAL LOSS OF AG AND FOREST LAND: 31,833 ACRES



we used several maps. Map 3.2-9 shows *Projected Population Increase 2010-2040 as an Indicator of Relative Forestry Impacts*. Map 3.2-10 shows *2040 Projected Population Density as an Indicator of Sustainable Commercial Forestry*. These maps are produced using the same method described in Section 3.2.1 for Map 3.2-2, in the subsection entitled *Land Use and Forestry: Historical Relationship, Context for Land Use Impacts*. Map 3.2-2, showing *2010 Population as an Indicator of Sustainable Commercial Forestry*, can be compared with the 2040 Map 3.2-10. In addition, Maps 3.2-3 through 3.2-8, which show estimated numbers of new residential lots per 1,000 acres of rural land, are also useful as a means to examine potential impacts at a finer grained scale.

We used two criteria to initially identify locales where estimated future development is projected at a level likely to impact the probability of commercial logging:

- Relatively large areas of forest where projected population change is shown as moderate or high on Map 3.2-9; and
- Areas that have changed from high or moderate probability of commercial logging on Map 3.2-2 to low probability of commercial logging on Map 3.2-10.

On these maps, Priority Funding Areas (PFAs) for development and public forested lands outside PFAs are shown in white. We also used maps 3.2-3 through 3.2-8 to see how projected growth might vary across affected parts of the landscape within each region and county.

Using multiple maps for these purposes is necessary because there are extensive areas throughout the state which, in 2010, are classified as low probability of commercial logging on Map 3.2-2. For this reason, it is impossible to detect significant potential population change by comparing such areas in 2010, on Map 3.2-2, to 2040, on Map 3.2-10. Map 3.2-9 helps detect these potential changes. On the other hand, some relatively low levels of estimated population increase on Map 3.2-9 (less than 25 persons per square mile) are enough to push those areas into the low probability range for commercial logging

on Map 3.2-10, but this cannot be seen without comparing the 2010 and 2040 maps.

Using the above criteria, these maps suggest four regions where forestry could be significantly impacted:

- In Western Maryland, Garrett County around Deep Creek Lake, north of Friendsville, and around/north of Grantsville;
- In Central Maryland, parts of rural Harford County;
- Much of Southern Maryland; and
- On the Lower Eastern Shore, around Salisbury in Wicomico County.

In all of these locales, fairly large tracts of forest still exist and still support industry infrastructure in the forms of loggers, mills and markets for their products. The threat is that the infrastructure—mutual reliance and relationships among loggers, mills and markets—in these areas will be undermined as fragmentation of forest tracts continues and residential population increases. As these changes occur, the incentive for forest industries to invest in infrastructure and actively manage forests declines. Specifically, as fragmentation by development proceeds, forest tracts become smaller and more difficult to manage and harvest, compromising supply; local mills close and loggers harvest from smaller tracts, to supply mills further away, but need larger tracts to overcome economies of scale presented by the greater distance between their harvests and the mills; and residential populations become increasingly intolerant of timber harvesting of the remaining forest in what has become their community. This has already occurred in some of the more highly developed suburban/formerly rural parts of metropolitan counties.

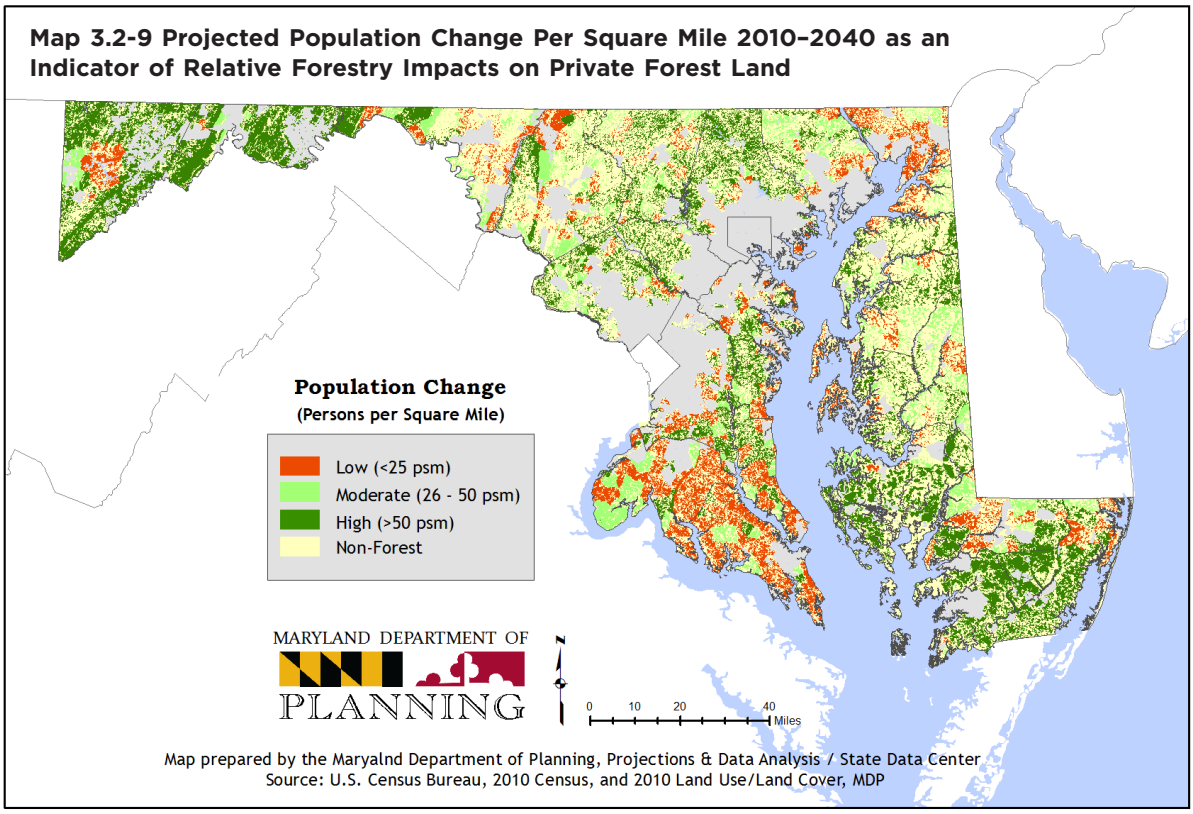
The maps can be used to identify areas in addition to those enumerated above that are also estimated to experience significant increases in population density, scattered throughout parts of the D.C. region, the Upper Eastern Shore and the Lower Eastern Shore. But these changes are projected to occur primarily on forested land that was already highly fragmented by land in agricultural production and/or development (on the Shore), or where industry infrastructure is already somewhat compromised in relative terms (in the D.C. region).

In Southern Maryland, estimated future fragmentation of forest landscapes can be seen by comparing the 2010 and 2040 maps, viewing Map 3.2-9, and by reviewing Map 3.2-7. At stake are local markets for high-quality hardwood, particularly from yellow poplar, pulpwood and white oak, which is prized by some markets. Some of the wood products from this area are very specialized (e.g., Steinway piano parts). Reduced access to timber resulting from fragmentation will make it difficult for loggers to supply that market, which they could lose. Southern Maryland loggers have already lost good local markets for pine sawlogs, such that many eschew work involving pine. The same thing may happen with hardwood. Pulpwood markets still reach into Southern Maryland, but ever-decreasing tract sizes make it harder to profitably target pulpwood as a primary product. Additional subdivision and development will exacerbate this problem, and pulpwood may become strictly a secondary product from sawlog harvesting or land clearing. If this occurs, or loggers lose their specialized poplar markets, industry infrastructure in the area may suffer.

The potential losses and fragmentation of forest in Harford County are suggested by Map 3.2-9 and reinforced by Map 3.2-4. From a forestry perspective, what's at stake in Harford County is loss of very high-quality hardwood sawlogs, which are used to produce considerable veneer and support a handful of small sawmills and one veneer exporter. If this supply chain breaks or becomes unstable, the biggest challenge will be investment to manage the remnant forests without the benefit of markets to pay for it.

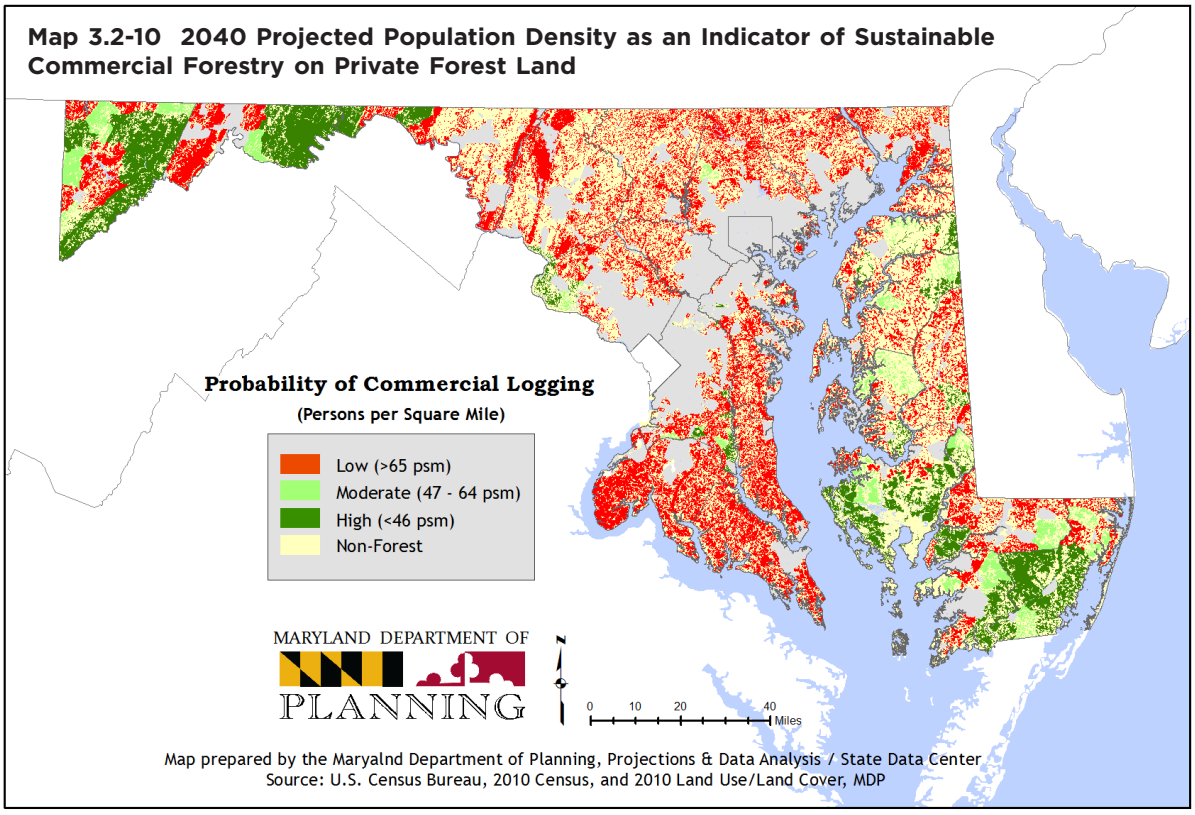
Implications of future development in Wicomico County are suggested by the three forestry maps and reinforced by Map 3.2-8. Wicomico is part of a pine "capital" on the Lower Eastern Shore, i.e., pine drives the ebb and flow of the wood industry. There is almost as much hardwood growing, but a lot of it is mixed with pines or is in swampy ground and is inaccessible. Large lot development

Map 3.2-9 Projected Population Change Per Square Mile 2010–2040 as an Indicator of Relative Forestry Impacts on Private Forest Land



Map prepared by the Maryalnd Department of Planning, Projections & Data Analysis / State Data Center
Source: U.S. Census Bureau, 2010 Census, and 2010 Land Use/Land Cover, MDP

Map 3.2-10 2040 Projected Population Density as an Indicator of Sustainable Commercial Forestry on Private Forest Land



Map prepared by the Maryalnd Department of Planning, Projections & Data Analysis / State Data Center
Source: U.S. Census Bureau, 2010 Census, and 2010 Land Use/Land Cover, MDP

in the region often takes place on what, to loggers, is winter-time "high" ground supporting pine. This land also supports on-site sewage disposal for large-lot development. Loss of forest land in this area will equate to a considerable loss of wood, but the loss of places to harvest during wet seasons will be perhaps more important than total acreage, as the former is a source of sustainable income for loggers and wood for their customers during winter. If Wicomico County experiences the growth estimated, buyers will look to other locales in the region for supply. Loss of Wicomico as part of the Lower Shore's supply chain may divide the industrial procurement zone for buyers into two zones, west and east of the county, each with very limited buyers but especially so in the western zone. This potential fragmentation of the industry has implications for landowners, who may not have access to a sufficiently competitive buyers' market to make production sustainable.

In Western Maryland, estimated land use impacts are indicated by examination of the three forestry maps in combination. At stake is high-quality hardwood timber. The indicated areas in Garrett County do not by any means comprise a majority of the forestland in the region, or even in Garrett County, but do represent significant portions of the private land within both geographies.

SUMMARY

As stated previously, 2040 land use and change estimates presented here should be interpreted as approximations, both quantitatively and geographically speaking. They may over or under estimate future land use changes in specific places, by region and statewide. That said, the general patterns and intensity of land use impacts projected are probably good indicators of what is likely to occur unless development markets, land use management plans and programs, or both, change substantially over the next 25 years.

In summary, impacts of more intrusive residential development are likely to occur in parts of all six regions:

- Livestock industries may be threatened or compromised in parts of Washington, Frederick, Harford, Cecil, Queen Anne's, Caroline and Wicomico counties. However, ample land will remain in Western Maryland and on the Eastern Shore to continue to support these industries in some areas.
- Trends of the last 75 years away from industrial-scale livestock and large-scale crop production towards nursery, greenhouse, fruits, vegetables, and alternative production geared toward emerging markets, are likely to continue everywhere in the state, both because fragmentation by residential development continues to erode the rural environment necessary to sustain livestock and large-scale grain production, and because markets for locally produced food are growing, providing the opportunity for small-scale, diverse, value-added farming and marketing that may be increasingly profitable.
- Forest industries may be compromised in parts of Southern Maryland, the Lower Eastern Shore, Central Maryland and Western Maryland, in decreasing order of the magnitude of potential impacts based on this land use analysis and consideration of the types of timber and markets in the regions.

Smart growth tools, primarily manifest through local comprehensive plans, zoning, development rules, and preservation programs, are helping enormously to limit these impacts in areas where they are most rigorously practiced. Of course, the magnitude of residential development markets—how many people and families are in need of housing, and particularly how many of them seek larger lots in suburban or rural locations—is also a factor of paramount importance. But observation of the patterns of residential development in the past, together with small area forecasts in counties with several rural zoning districts, strongly suggest that where rural zoning is protective—allowing subdivision of one or fewer residential lots per 20 acres—markets are deflected away from agricultural and forested lands to areas planned for denser development. The more restrictive the zoning—e.g., one lot per 50 acres is more restrictive than one lot per 20 acres—the greater this deflecting effect is likely to be for a given market.

Based on our analysis, the effects of the Septics Bill—the Sustainable Growth and Agricultural Preservation Act of 2012—will primarily be to reduce subdivision capacity in Tier IV areas, dispersing development sooner than might have occurred without the act, and ultimately reducing the number of residential lots in those areas at "build out"—i.e., when all the lots that can be have been subdivided and built under existing zoning and subdivision limits. The degree to which these limits result in residential populations compatible with farming and forestry depends primarily, as it did before the act, more on local zoning than on implementation of the act.

3.3 Other Potential Sources of Land Use Change

3.3.1 Estimated Land Use Change Resulting from Climate Change Impacts

Figure 3.3-1 shows the estimated number of acres of agricultural and forest lands that would be lost as a result of inundation by the year 2050 if an approximate two-feet rise in sea level occurs as projected. Roughly 14,000 acres of agricultural land—less than 1 percent of the statewide total—and 66,000 acres of forest land (roughly 3 percent) would be impacted.

Figure 3.3-2 shows the estimated number of acres that would be impacted by a Category 5 Storm Surge under a two-foot sea level rise scenario: 200,000 acres of agricultural land (10 percent of statewide totals), and 325,000 acres of forest land (13 percent).

Storm surge is produced by water pushed inland by the force of winds of large, relatively violent storms like hurricanes. It is a very complex phenomenon that varies tremendously among locations within regions, states and counties, depending on a number of factors. Hurricane Donna, for example, in 1960 caused storm surges varying from four to eight feet in North Carolina and from five to 10 feet along portions of the New England coast.

Unlike sea level rise, storm surge is temporary. However, the damage it can cause to forest and agricultural land, by introducing salt water to the soil, can be permanent.

We focused on Category 5 storms not because they are particularly likely, but because they represent a worst-case scenario, the most geographically

Figure 3.3-1 Statewide Resource Lands Potentially Lost to 0–2′ Sea Level Rise Projected by 2050

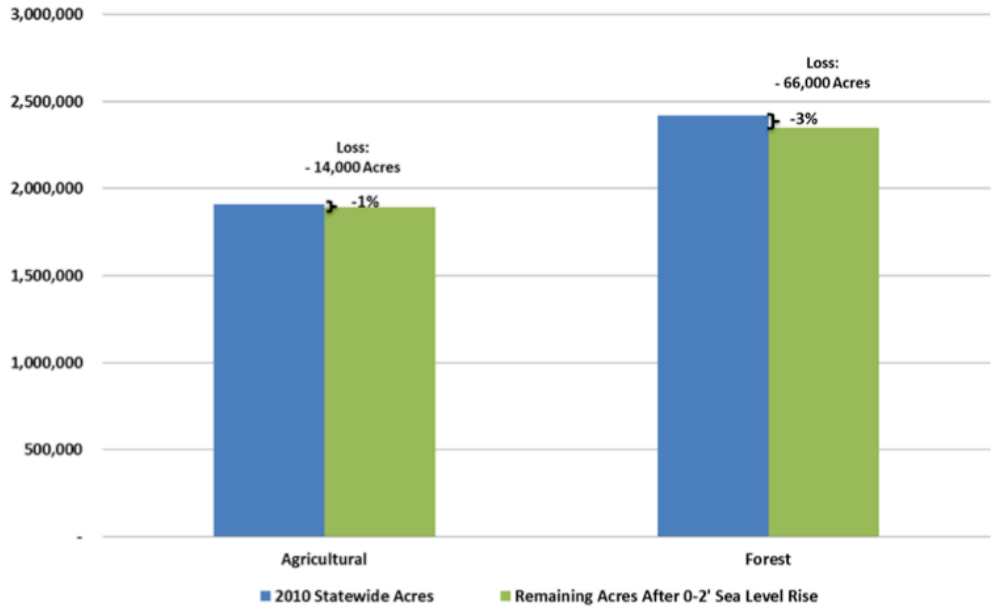


Figure 3.3-2 Statewide Acres Potentially Affected by Storm Surge (Category 5 Storm)

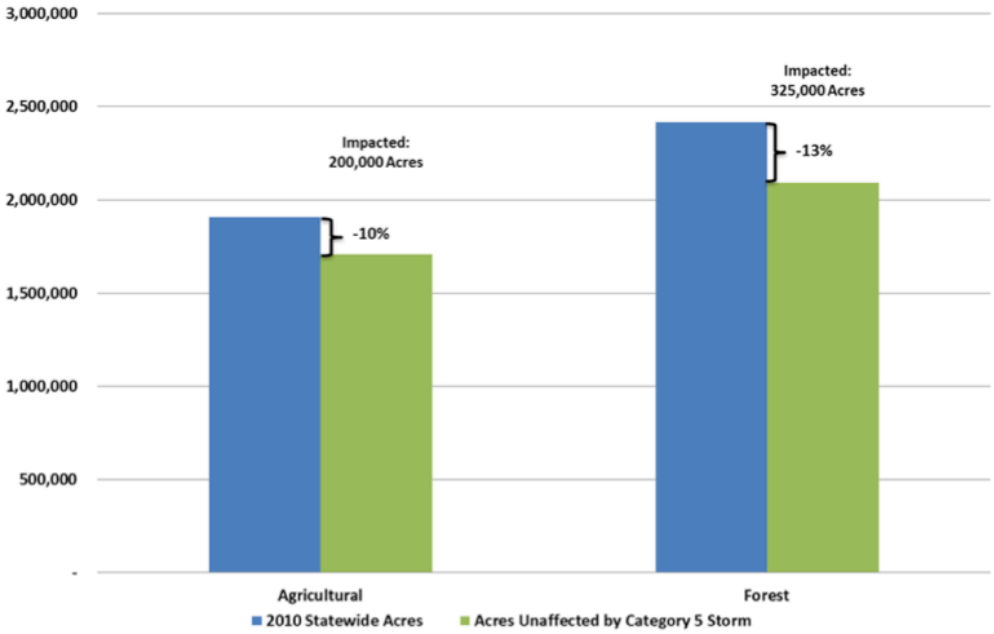
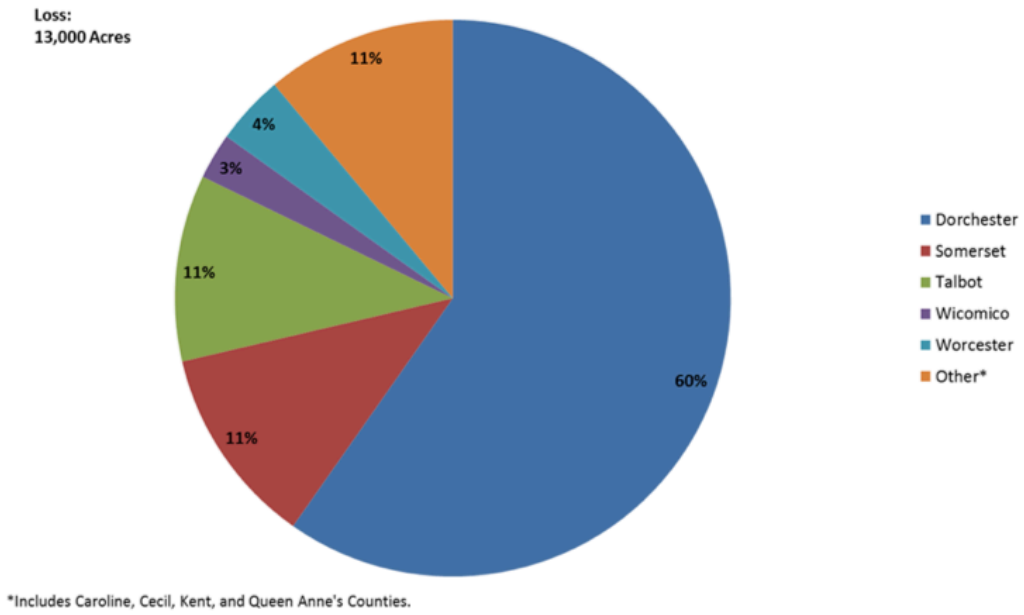


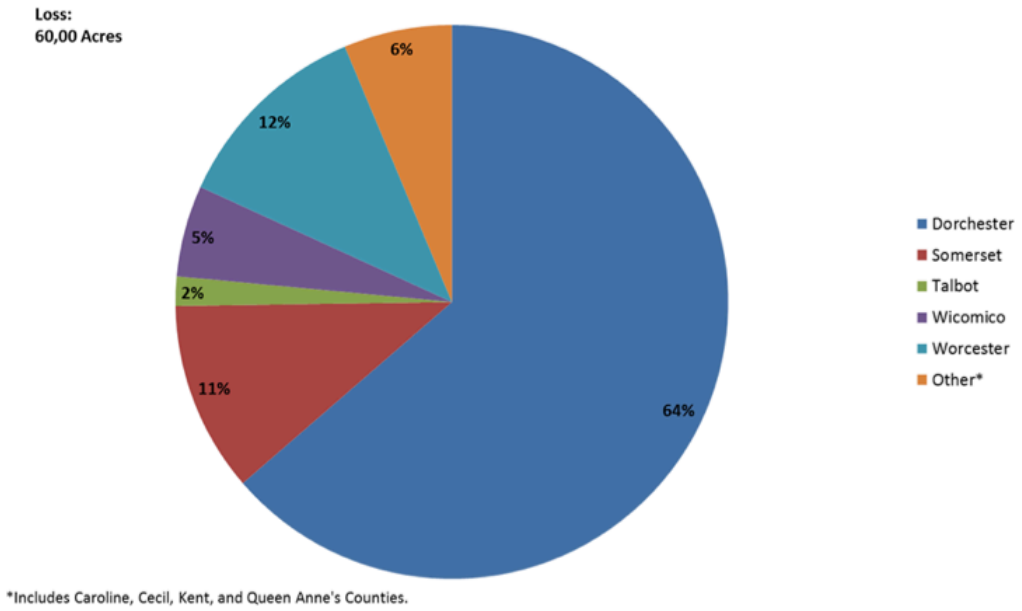
Figure 3.3-3 Potential Loss of Agricultural Lands to 0–2 ft Sea Level Rise Maryland's Eastern Shore (as % of E Shore Total)



extensive damage that could occur to farm and forest lands as a result of climate change. Past storm surges in Maryland have been on the order of Category 2 storms.

The potential impacts of sea level rise appear most significant if considered for the Eastern Shore alone, where the majority of statewide impacts will occur. Figure 3.3-3 shows the estimates for agricultural land impacted for the Shore by county. Figure 3.3-4 does the same for forest lands.

Figure 3.3-4 Potential Loss of Forest Lands to 0–2 ft Sea Level Rise Maryland's Eastern Shore (as% of E Shore Total)



Thirteen-thousand of the 14,000 acres of agricultural land to be lost to sea level rise will be on the Shore, with the majority occurring in Dorchester County (7,800 acres) followed by roughly 1,430 acres in each of Somerset and Talbot, and less than five percent (650 acres) in each of the remaining Shore counties of Wicomico, Worcester, Caroline, Cecil, Kent and Queen Anne's.

The prognosis is similar but greater in absolute magnitude for forest lands (Figure 3.3-4). Sixty thousand of the 66,000 statewide acres of forest lands potentially lost to the sea will be on the Eastern Shore, again with the majority in Dorchester County (38,400 acres), followed by roughly 6,600 to 7,200 acres in each of Somerset and Worcester counties, and smaller but significant acres in each of the other Shore counties.

If these projections come to pass, they may have significant impacts on farming and/or forestry in Dorchester (both industries), Somerset (both), Talbot (agriculture), and Worcester (forestry) counties. Because they will not result from fragmentation by residential development, their effects on landowners, operators and the industries will be different from those (discussed above) resulting from development-driven land use change. The effects are more likely to be on specific landowners, farmers, and operations closest to tidal shorelines.

Potential impacts of Category 5 storm surge are not only much greater, in terms of geographic extent, but also more ambiguous, in that what "category storm" will affect what sections of Maryland's shoreline in the next 25 years is essentially unknowable.

That said, the impacts of the worst case scenario—Category 5 storm surge impacts everywhere—on the Eastern Shore would be formidable. Figure 3.3-5 shows that 176,000 of the 200,000 acres of agricultural land potentially impacted would be on the Shore, with the proportional distribution similar to that projected from sea level rise: over 60,000 acres in Dorchester County, followed by about 32,000 acres in Somerset, 28,000 in Talbot, 23,000 acres in Worcester, and considerably fewer acres in each of the remaining Shore counties.

258,000 of the 325,000 acres of forest potentially impacted by storm surge are on the Eastern Shore (Figure 3.3-6), with 98,000 of them in Dorchester, 52,000 in Worcester, 49,000 in Somerset, and

Figure 3.3-5 Potential Loss of Agricultural Land to Category 5 Storm Surge, Maryland's Eastern Shore Counties (as % of E Shore Total)

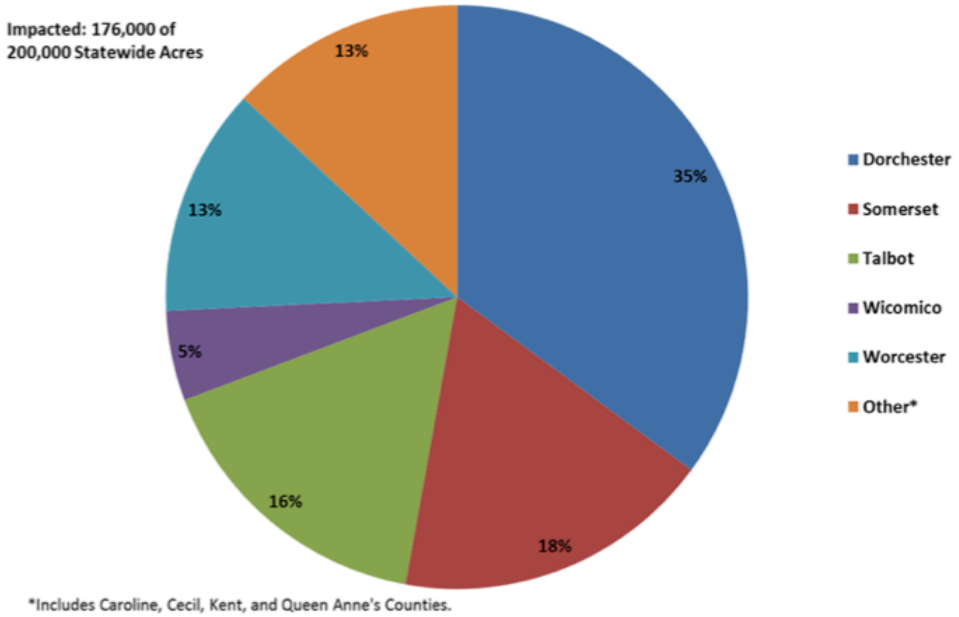
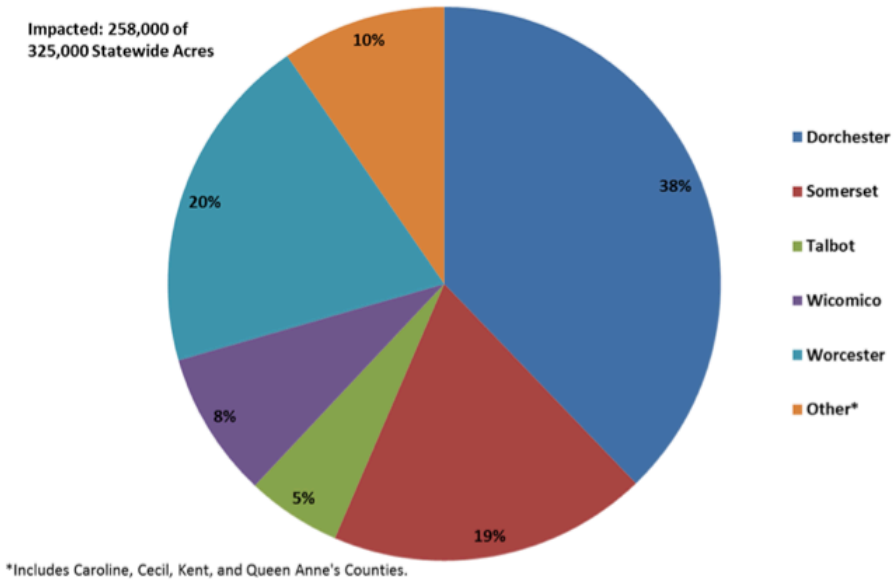


Figure 3.3-6 Potential Loss of Forest Lands to Category 5 Storm Surge Maryland's Eastern Shore Counties (as % of E Shore Total)



roughly 20,000 acres or less in each of the other Shore counties.

Should a geographically widespread Category 5 storm hit Maryland, the impacts on both industries could be enormous. In considering these implications, it is important to recognize, however, that whatever the magnitude of storms to hit Maryland in the next 25 years, they will undoubtedly not be geographically uniform and will not occur everywhere. The magnitude of widespread Category 5 impacts notwithstanding, for purposes of this project, their influence on the sustainability of farming and forestry is largely conjecture. Impacts in specific locations will

Table 3.3-1 Maryland Chesapeake Bay Watershed

BMPs That Impact Agricultural Land Use	Land Use Conversion Type (Pre-BMP LU to Post-BMP LU)	Acres Converted as of 2010 (% Final Goal)	2025 Final Goal	Additional Acres Converted 2010 - 2025
Forest Buffers	Ag to Forest	20,926 93%	22,471	1,545
Grass Buffers/ Vegetated Open Channel	Taken from Cropland	46,265 92%	50,028	3,763
Land Retirement	Cropland Retirement	19,118 33%	57,186	38,068
Tree Planting Vegetative Environmental Buffers	Cropland to Forest	17,484 95%	18,313	829
Wetland Restoration	Ag to Wetland	8,218 65%	12,734	4,516
Total Acres Converted		112,011 70%	160,732	48,721

Figure 3.3-7 Potential Conversion of Agricultural Land to Other Uses, BMP Implementation, 2010–2025, State of Maryland; 48,721 Acres

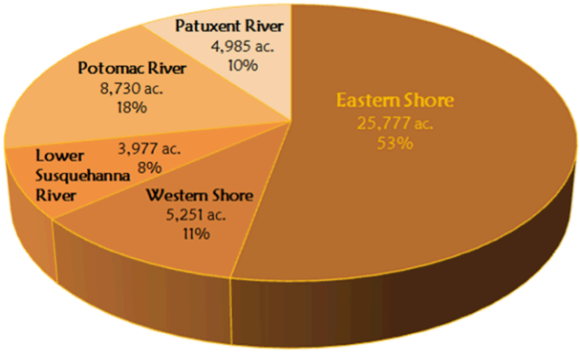
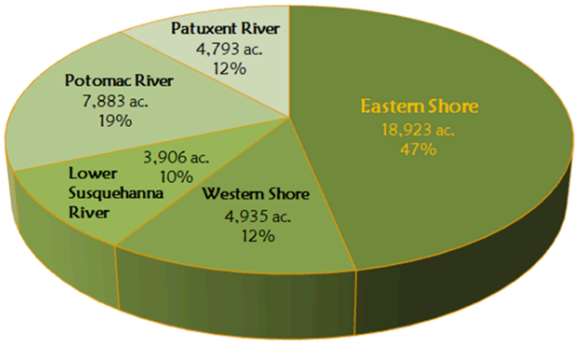


Figure 3.3-8 Potential Conversion of Agricultural Land to Forest, BMP Implementation, 2010–2025, State of Maryland; 40,442 Acres



undoubtedly occur, but we don't know where or to what degree. This is not to say that the impacts will be negligible relative to those from development and sea level rise, but they are much less certain and much more difficult to prepare for.

3.3.2 Estimated Land Use Change Resulting from BMP Implementation

Table 3.3-1 lists BMPs from Maryland's Watershed Implementation Plan for the Chesapeake Bay TMDL that convert agricultural land in production—generally cropland or pasture—to other uses.

As of 2010, tracking of BMPs indicates that implementation has converted a total of 112,011 acres of these forms of farmland to forest, wetland or other cover types like grass.

As shown in the table, two of the practices—forest buffers and tree planting—have converted, as of 2010, roughly 38,500 acres to forest or an earlier successional stage expected to become forested cover. Some of the retired cropland (land retirement)—57,186 acres as of 2010—may also become forest.

By 2025, it is expected that additional acres will be converted through all of these practices, as shown in the table, to reach the 2025 Final Goals. At that time, 160,732 acres will have gone out of production, most of it probably formerly cropland. Of this land, 48,721 acres will have been converted between 2010 and 2025, which we will consider here as future potential loss. The vast majority of land cover conversion will occur through land retirement—roughly 38 of 48 thousand acres—which may or may not result in additional forested cover.

As shown in Figure 3.3-7, more than half (53 percent) the farm acreage converted after 2010 will be on the Eastern Shore, with successively smaller fractions of the total occurring in Maryland's portion of the Potomac River basin (18 percent) followed by the Western Shore (11 percent), Patuxent (10 percent) and Lower Susquehanna (8 percent) basins.

These acreages, especially on the Eastern Shore, are not insignificant. But relative to land use change likely to result from development and impacts that could result from climate change, their impacts on the agricultural industry are likely to be relatively minor. This is especially true when one considers that much of the land converted from agricultural uses may be marginal, comparatively speaking, in terms of production. For example, much land that is retired through practices implemented through the Conservation Reserve Enhancement Program is erodible and/or is likely occur on steeper slopes or in riparian areas.

It is also difficult to conclude with any certainty how much of the land converted to forest is likely to support commercial timber management and harvesting. Figure 3.3-8 shows the percentages and amounts of the roughly 40,000 acres converted as a result of forest buffers, land retirement and tree planting. Some of this could become commercially viable for timber. But it will occur on the same marginal lands mentioned above, and in some cases probably in relatively linear (as in forested buffers along streams) and sometimes fragmented (land retirement and tree plantings) configurations, as opposed to larger contiguous blocks of timber that might be easier and more economical to manage and harvest.

The geographic distribution of farmland potentially converted to forested cover is similar to that of all the farmland potentially converted from agricultural to other cover types and uses. The greatest potential will be on Maryland's Eastern Shore, followed by the Potomac, Western Shore, Patuxent and Lower Susquehanna River basins, as shown in Figure 3.3-8.

3.4 Methods: Estimating Future Growth, Development and Land Use Change

The Maryland Department of Planning (MDP) has for some time estimated future land use change using a simple growth simulation model (GSM) of its own design. Several major enhancements to the GSM were made that substantially improve the ability of the model to estimate where and how much land may be developed for residential development in the future, by better representing the factors described below.

In making these enhancements, we focused on residential development for this project. The vast majority of development on resource lands is residential, and the purpose of this project is to estimate conversion of rural resource lands to development. We plan similar enhancements for estimating commercial, industrial and institutional development, but did not implement them at this time. Future non-residential development was estimated using existing model algorithms, adapted to the new geographies (described below) used for residential development. Estimation procedures are described below following discussion of those used for residential development.

3.4.1 Land Use Change Resulting from Residential Growth and Development

The Growth Simulation Model (GSM) follows these steps for residential development; quoted terms are explained in the narrative:

1. Population/Household Projections: County or TAZ (Transportation Analysis Zone—metropolitan counties only) level projections are compiled as input to the model
2. Inventories of Recent Past Residential Development by county, "small area," and "zoning/sewer district" are completed
3. Initial allocations of countywide residential projections are made to small areas in non-metropolitan counties
4. Initial allocations of small area residential "control totals" are made to zoning/sewer districts
5. Allocations of zoning/sewer district residential "control totals" are made to parcels
6. Excess allocations of residential projections to zoning/sewer districts are reallocated to other zoning/sewer districts within the same small areas

7. Excess allocations of residential projections to small areas are reallocated to other small areas, then to zoning/sewer districts within them
8. Future land use change is estimated by parcel
9. Future land use change estimates are aggregated by zoning/sewer district, small area, county, region and statewide

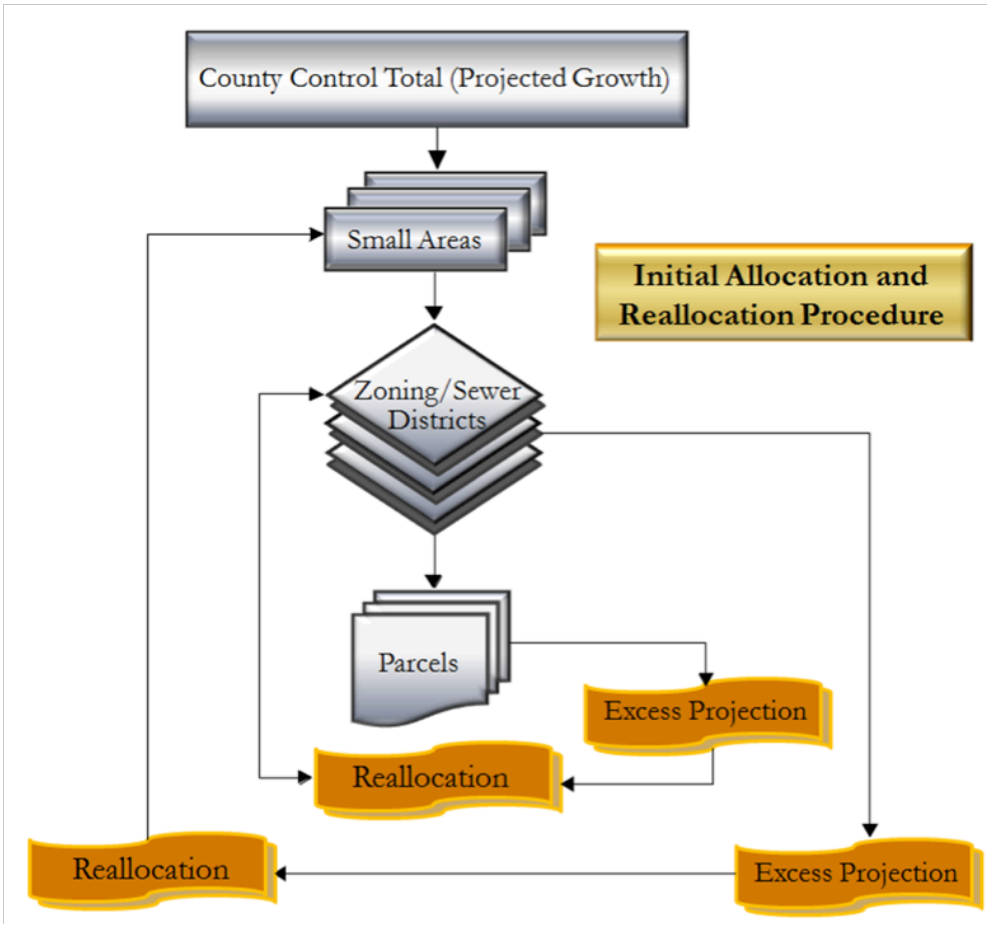
3.4.2 Modeling Geographies

Several types of "nested" geographies—areas that fit within and collectively comprise larger areas—are used to organize the GSM. These geographies and the procedures described in this section are schematically illustrated below.

The first (largest) of these is the county level, which here includes Baltimore City in addition to Maryland's 23 counties.

Within any given county, the model uses one of two types of "small areas." In counties that comprise the major metropolitan planning areas of the Metropolitan Washington Council of Governments and the Baltimore Metropolitan Council (which collectively are also called "MPOs," or Metropolitan Planning Organizations), the model uses small areas called Transportation Analysis Zones (TAZ). For other counties, the model uses Census Block Groups as their small areas.

Within small areas, the model uses local zoning district boundaries in combination with local sewer service boundaries, which for convenience are called "zoning/sewer districts." In the model, zoning/sewer districts within small areas correspond to the combined boundaries of these two features. For example, a hypothetical "R-4" zoning district, for residential development at four residences per acre, and a local "current sewer service" district, together comprise areas zoned for four residences per acre that already have direct access to sewer service we might classify as R-4/sewer.



Finally, within zoning/sewer districts, the model uses real property parcels, or parcels of land with unique identifiers in the Maryland Department of Assessments and Taxations database and MDP's GIS version, called MD Property View.

3.4.3 Population and Household Projections

Through its State Data Center, MDP works closely with the U. S. Census Bureau to monitor development trends; analyze social, economic and other characteristics; and prepare population, housing, employment, labor force and income projections, which provide the baseline for planning for growth and development in the state. These projections are the principal driver of growth and development as estimated by MDP's GSM.

For this project, population and household projections for the year 2040 were used.

Population and household projections are initially made by county. In metropolitan counties, a procedure called cooperative forecasting, carried out in collaboration by the MPOs, counties and MDP, is used to allocate countywide projections to TAZs (the model's "small areas" within metropolitan counties). Market forces are one of the factors considered. For this project, TAZ projections from the cooperative forecasts for metropolitan counties are one of the ways in which effects of market forces are represented.

For counties outside metropolitan planning areas, countywide forecasts were allocated to Census Block Groups, the small areas analogous (for purposes of the growth model) to TAZs in metropolitan counties. The procedure used to do this is described in the next four sections: Recent Trends, Development Capacity, Initial Allocation of Projected Growth, and Reallocation. This procedure is another way in which effects of market forces are represented, in the analysis.

3.4.4 Past Trends

The way in which MDP's growth model uses projections to simulate future development is substantially influenced by extrapolation of past trends into the future. Past trends are based on an inventory of residential development over the last 20 years. The number of residential units built over that period is inventoried at the three nested geographic levels discussed previously: within counties, small areas within counties and within zoning/sewer districts in small areas.

The purpose of the inventory is to calculate the percentages of recent past development occurring at each nested level. Residential units built within small areas outside of MPO areas (TAZ projections are used in MPO counties) are calculated as percentages of county totals. Residential units built within zoning/sewer districts are calculated as percentages of small area totals. The completed inventory of recent past development accounts for the distribution of recently built housing units by zoning/sewer district within small areas used in the model. This proportional distribution of new households during the last 20 years is used to initially allocate projected growth, and reflect recent and presumably continuing market forces.

3.4.5 Development Capacity

In addition to the distribution of recent residential development, another factor used to geographically "place" projected growth into smaller areas is development capacity. As used here, the term means the number of new housing units most likely to be developed on a given parcel of land (assuming there is adequate demand) under current zoning and development rules and other considerations.

To estimate development capacity, we consider:

- The zoning of parcel;
- The sewer service status of a parcel;
- The zoning and development rules generally governing development in the zoning district;
- Easements or other restrictions/conditions applying to the parcel;

- Realized densities, a measure of the density of development typically occurring on properties developed in the zoning district with a given sewer service status during the last 20 years;
- The portions of a parcel that might be restricted from development by environmental features (e.g., the presence of wetlands or steep slopes) based on local regulations;
- The presence or absence of previously existing residential development on a parcel.

Information on realized densities per zoning district is derived from numerous sources. Zoning ordinances and related development regulations are used to estimate the "yield," or the number of residential units likely to result from the development process. Digital GIS data is used to measure the size and estimate the density of residential units already developed in each jurisdiction. We also work with local government planning staff to inform this process. If indicated, estimated yields of residential units suggested by the zoning ordinance are adjusted. In the best case, local governments compile data on residential yields by zoning district and provide MDP with their own estimates of realized densities, which are then used for this purpose in the model.

Data on other parcel attributes that restrict development are derived from a variety of GIS data sources: zoning and sewer service from county maps; easements and other restrictions from a comprehensive state/local protected lands data base; environmental features from data on wetlands, waterways and slopes; and data on roads that affect development capacity and yields in some zoning districts in some jurisdictions. Zoning ordinances and/or development regulations are the primary source of information about how these features might affect capacity and yields.

These considerations are used to estimate the development capacity of each parcel of land that is zoned to allow residential development.

3.4.6 Initial Allocation of Projected Growth

Initial allocation of projected growth means allocation of growth in households from the scale at which projections are available to smaller geographic scales.

In metropolitan counties, this requires only one step: initial allocation of small area (TAZ) projections to zoning/sewer districts.

In non-metro counties, initial allocation requires two steps:

- Allocation of county-wide projections to small areas (Census Block Groups), and
- Allocation of Census Block Group control totals to zoning/sewer districts.

In non-metro counties, county-wide projected numbers of new households are initially distributed among small areas (Census Block Groups) according to "recent trends," i.e., the proportion of recent county growth that occurred in each small area during the past 20 years. In the second step, the resulting small area "control totals" are distributed among zoning/sewer districts in proportion to the percentage of growth that occurred in each of them during the past 20 years.

In metropolitan counties, countywide allocation to small areas has already occurred through cooperative forecasting, as referenced above, so TAZ projections are distributed directly to zoning/sewer districts.

The number of projected new housing units initially allocated to each sub-geography constitutes an initial "control total" for the area, a term useful in describing the reallocation procedure below.

The final step in the initial allocation of control totals—to parcels—is described in the next section.

It is worth noting here that the past 20 years encompasses what one might call periods of relative economic and real estate boom and bust. Before 2007, demand for and prices of real estate for residential development were high;

afterwards, both declined, and have only increased to small or modest degrees in different places. Aggregate estimates of recent trends as defined here incorporate the geographic distributions of market activity prevalent during both periods, with the aggregate necessarily representing the boom distribution more than the bust, since the majority of new residences were developed during the former.

Consequently, the accuracy of growth model estimates depends in part on the degree to which future development patterns mimic those of the last 20 years in counties lacking small area forecasts. In metropolitan counties, TAZ forecasts provide control totals for small areas, and their accuracy is undoubtedly highly variable and is a function of insights used in the cooperative forecasting process. In non-metropolitan counties recent trends do influence the small area allocation procedure, and in both metropolitan and non-metropolitan counties they influence zoning/sewer district allocation. The relevant question is, as market demand for housing recovers, will its geographic distributions at these scales resemble those of the last 20 years, or differ substantially from it, and if the latter, why and how?

Whatever the answers may be, unless state and local policy and implementation tools change substantially, development and consumer markets will have the same geographic playing field and the same development opportunities and lifestyle attributes from which to choose. Unless markets and market preferences change substantially, they may make similar choices. There are some indicators of changes in market preferences, particularly among young adults in metropolitan areas. Thus far, this appears to be a fairly localized phenomenon that is better represented through the cooperative forecasting process involving local governments than through MDP's growth model.

3.4.7 Allocation to Parcels and Reallocation

Allocation to parcels occurs as follows:

First, new housing units allocated to the zoning/sewer district with the largest control total within the small area are allocated to parcels with development capacity as follows.

Allocation to parcels occurs in a sequence for which parcels are ranked based on an aggregate measure of proximity to:

- Existing sewer service;
- Major roads;
- Residential developed land;
- Commercial developed land; and
- Transit stations.

Most existing residential development in Maryland has occurred and continues to occur in proximity to these features, and we expect this pattern to continue. This aggregate measure of proximity of parcels to features is used to rank them according to their relative probabilities of development. Only parcels that are otherwise relatively similar are ranked in this way; specifically, within any group of ranked parcels, all of them are in the same zoning/sewer district within the same small area. Parcels planned for high-density multifamily construction are not, for example, being ranked against those planned for agricultural resource conservation. The relative likelihoods of market demand among parcels that differ in these ways have already been addressed through the initial allocation process, specifically through small area and zoning/sewer district allocation.

If there is insufficient aggregate parcel development capacity within a zoning/sewer district to "accommodate" the district control total, the excess initial allocation (the difference between the control total and the aggregate parcel development capacity) is reallocated among remaining zoning/sewer districts within the small area.

This procedure—allocation to parcels and reallocation to zoning/sewer districts—is repeated, first by zoning/sewer district within the first small area, and then within each remaining small area in the county. If there is insufficient aggregate development capacity within a small area to accommodate the small area control total, the excess initial allocation is reallocated among

the remaining small areas within the county, in descending order of TAZ forecasts (metro counties) or small area control totals (non-metro counties).

3.4.8 Redevelopment, Infill and Future Annexations

For purposes of estimating future impacts of growth under existing programs on resource lands, redevelopment, infill and development in future municipal growth areas that may or may not be annexed are three phenomena that are difficult to represent. Overestimating them would direct more growth to designated growth areas at higher densities than warranted by existing plans and programs, and would correspondingly underestimate conversion of resource lands. Underestimating them would have the opposite effect—it would push projected new households (in the reallocation procedure described above) from growth areas into other areas, possibly including rural areas.

We only attempt to estimate these phenomena when specific information is available from local governments to guide us in the form of pipeline development data (explained below). Without these data, we estimate infill, redevelopment and development in future growth areas assuming current zoning, existing development rules and existing development.

By pipeline development, we mean subdivision and development that has been approved by a local government at densities higher than would normally be allowed by our zoning data in the relevant area. We are alerted to this possibility when forecasts are large compared to our development capacity estimates for the area (see section 3.4.5). If we can obtain information to support it, we then estimate infill and/or redevelopment beyond an area's estimated capacity.

Without specific information about expected demand, the timing of annexations, and intentions for development in annexed areas, it is not possible to estimate how much, what kind of development and when it will occur in these areas without making unfounded assumptions.

Thus, in summary, we err on the side of caution in estimating these phenomena: we don't estimate them beyond current zoning in the absence of data to support the estimates.

3.4.9 Land Use Change

Existing land use/land cover comprising each parcel of land is estimated by superimposing parcel centroids in a Geographic Information System on 2010 land use/land cover data and assigning the congruent land use/cover type to the parcel. The amount of land converted to residential development on each parcel is based on the number of residential housing units allocated to the parcel; the acreage needed to accommodate those units based on zoning, subdivision and development rules applying to the zoning/sewer district; and consideration of environmentally restricted land cover types present on the parcel, if any (the latter is determined through a GIS overlay of parcel boundaries with sensitive area data). The amount of each parcel and its assigned land use/land cover converted to development is based on the amount of land needed to accommodate the new household allocation, which depends on zoning, sewer service and subdivision and development rules that apply to the parcel and the zoning district.

3.4.10 Land Use Change Resulting from Commercial/Industrial Growth and Development

In describing how the model estimates future non-residential growth and development, wherever the term "commercial/industrial" is used in relation to estimation or calculation of a parameter, it means that the parameter mentioned is estimated or calculated separately for both commercial and industrial land use and development. Other terms used (e.g., "small area") have the same meaning as that described above for residential development, or are explained below.

For this project, employment projections for the year 2040 were used (http://planning.maryland.gov/msdc/S3_Projection.shtml). See *Total Jobs by Place of Work* by Jurisdiction, and *Total Jobs by Place of Work by Industry*. All jobs were classified as either "commercial" or "industrial," based on the kind of development typically associated with likely places of employment.

Employment projections at the county scale were compiled as input to the model. In each county these steps were followed:

1. Inventory acres of existing, developed commercial/industrial land use in each small area;
2. Calculate percent of total county existing, developed commercial/industrial land use occurring in each small area, to establish both the current rates at which these land uses are distributed among small areas, and to set the initial allocation rates for countywide employment projections;
3. Initially allocate countywide projected new employment totals to small areas, in proportion to each area's set percentage of existing commercial/industrial land uses. These allocations constitute initial small area control totals;
4. Calculate ratios of current commercial/industrial jobs to existing, developed commercial/industrial acres in each small area, to establish the average rate (number of jobs per acre) at which commercial/ industrial jobs have been accommodated, and to set the rate at which future jobs allocated to each small area will be accommodated;
5. Inventory unimproved, commercial/industrial zoned parcels with capacity for development in each small area;
6. Starting with the small area with the highest initial control total, randomly allocate small area new employment control totals to commercial/industrial parcels with capacity within the area, at the rate (number of jobs per acre) set for the small area;
7. Convert the acreage of each parcel receiving an allocation to commercial/industrial land use, by using the size (acreage) of each parcel and the ratio of current commercial/industrial jobs to existing developed commercial/industrial acres established for each small area;
8. If all unimproved commercial/industrial parcels in a small area are "developed" before the entire control total for the area has been allocated to parcels, add the excess allocation (initial small area allocation minus the number of jobs already accommodated) to the control total for the small area with the largest remaining control total;
9. Continue and repeat the process from step 6 until all projected jobs have been allocated to parcels;
10. Sum the numbers of jobs allocated and number of acres converted to commercial/industrial land uses in each small area, each county, each region and statewide.

It should be noted that employment and considerable commercial uses in some places may occur on land zoned for residential use. This land might otherwise be used to accommodate residential development. If this occurs to significant degrees in an area, residential development projected for this area could be "pushed" to other locations, including rural lands, more than would otherwise be the case. We were unable to estimate where and the degree to which this phenomenon is likely to occur in the future. Our resulting estimates do not therefore account for it. Consequently, our estimates of resource land conversion might be low in locations where this phenomenon continues to be a factor. This deficiency in the model will be addressed in future enhancements.

3.4.11 Potential Effects of Growth Tier Designation

The Sustainable Growth and Agricultural Preservation Act of 2012 allows all local governments to designate four "tiers" of land use categories to identify where major and minor residential subdivisions may be located in a jurisdiction, and what type of sewerage system will serve them. Major subdivisions are developments producing a number of separate residential lots that exceed the threshold established by each local

government. The maximum threshold is seven; some counties have lower thresholds.

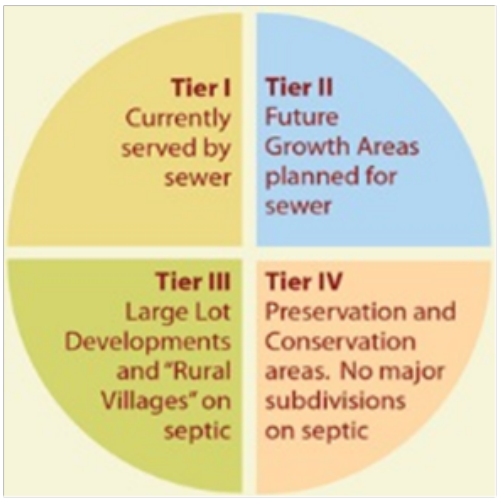
- Tier I areas are currently served by sewerage systems. Major subdivisions may occur.
- Tier II areas are planned to be served by sewerage systems. Major subdivisions are prohibited until sewer service is established and the areas become Tier I.
- Tier III areas are not planned to be served by sewerage systems. Major subdivisions on septic systems can occur.
- Tier IV areas are planned for preservation and conservation. Major residential subdivisions are prohibited.

The four tiers are graphically illustrated at top right. One effect of tier designation is to reduce development capacity of some properties outside of planned service areas in Tiers II and IV, and therefore the aggregate capacity of all properties in those tiers. For example, if a parcel in Tier IV, prior to tier designation, would have had development capacity of 12 lots, its capacity after designation is reduced to seven or less if the major/minor subdivision threshold for the county is less than seven. The result is that no more than seven lots (or fewer in some counties) can be created from the parcel.

To represent this effect in the model's estimates of land use change, the threshold limit is applied to all parcels in Tiers II and IV with capacities above the threshold for the county, effectively simulating prohibiting of major subdivisions as required by the law through the model.

The net effect of these changes in the growth model will be to spread future development in Tier IV more broadly among parcels within any given district, simply because fewer new residential units will fit on parcels that previously had large capacities.

Research by David Newburn on development in Baltimore County's rural areas suggests that rural downzoning increased the size and reduced the density of developed residential lots in those areas, but had minimal effect on the probability of development. In other words, locations that were



downzoned were just as likely to be developed after downzoning.* But since the number of lots allowed by restrictive zoning is less, the net effect is a decrease in density—the number of new lots developed—on many individual properties, and presumably on other land yet to be developed in downzoned areas. Essentially, the effect is to shift the type of development from major to minor subdivisions in the downzoned area. This is one of the intended effects of the Sustainable Growth and Agricultural Preservation Act of 2012, represented in the analysis through the use of thresholds as described above.

Another possible effect of the act is that, on large parcels, the amount of resource land remaining in forest or agriculture following development might be larger than it would have been prior to enactment. This might occur, for example, if development rules for the district limit lot size, and require lot clustering and/or preferred lot locations. Some counties' rules also require what may be called "preserved remainders" of resource land—resource land that is essentially left intact during and after subdivision and development, often with permanent easements on the remainders. We represent these phenomena where local ordinances and regulations require them.

* Newburn, David and Jeffrey Ferris. 2016. "The effect of downzoning for managing residential development and density." *Land Economics* 92(2): 220-236.

3.4.12 Possible Impacts of Climate Change on Land Resources for Farming and Forestry

We used storm surge risk GIS data obtained from Maryland Department of Natural Resources (based on a National Weather Service model called SLOSH that estimates storm surge heights from historical, hypothetical, and predicated hurricanes*), and sea level rise data (also from DNR) that shows projected sea level rise for the years 2050 and 2100, roughly corresponding to 0 to 2' and 2' to 5'. We coupled these data sets with MDPs 2010 land use/land cover data, and estimated the amounts of agricultural and forestland that might be lost or impacted by 2050 as a result of these phenomena if they occur.

3.4.13 Loss of Agricultural Land through BMP Implementation

Maryland's Watershed Implementation Plan for the Chesapeake Bay TMDL (Total Maximum Daily Loads) sets target year 2015 implementation levels for a host of Best Management Practices (BMPs) that reduce nutrient and sediment nonpoint source pollution loads from agricultural and forested lands. Some of these practices take agricultural land out of production and convert it to other uses. For example, one practice converts cropland or pasture in riparian areas (land adjacent to a stream or waterway) to forest.

In estimating land use change for this project, we wanted to account for the amounts of agricultural land that might be "lost" through BMP implementation, and the amount of forest land that might be created. To do so, we compiled inventories of target implementation levels for these practices for the entirety of Maryland's Chesapeake Bay Watershed, and for each of the five major sub-basins comprising the watershed. We then review them in context of land use/land cover changes anticipated from development and climate change impacts.

* Maryland Department of Natural Resources, Storm Surge Risk Areas, www.dnr.state.md.us/climatechange/data_guide.asp.

Chapter 4: Conclusions and Recommendations

We sought to answer three over-arching questions for this study:

1. Where do Maryland farming and forestry appear to be headed under existing key trends in markets, profitability and land use change?

2. Where (geographically) and what kinds of farming and forestry might be most affected by land use changes and recent environmental and policy initiatives in Maryland, and which might be most sustainable?

3. How might public policies be adapted to minimize negative and maximize positive effects of Bay Restoration, smart growth initiatives and important externalities on the sustainability of farm and forest production and marketing options?

This chapter consists of three sections that correspond to these questions, summarizing answers derived from our efforts thus far and the contributions of the experts we've consulted.

In Section 4.3, we recommend possible actions that government and private sector interests might consider to better support sustainable agricultural and forestry industries based on the challenges discussed in preceding chapters. Recommendations are deliberately general because more specific strategies can best be formulated by implementing parties.

4.1 Where do Maryland Farming and Forestry Appear to Be Headed Under Existing Trends in Key Externalities?

In Chapter 1, we made the observation that, before one can begin to forecast the potential impacts of smart growth initiatives and environmental regulations on the future of sustainable agriculture and forestry, it is important to consider historic and emerging trends and what is driving them. We reviewed those trends in some detail in Chapter 1 and provide an overview here.

AGRICULTURE: From the beginning of the twentieth century to its end, agriculture in Maryland was altered profoundly—from a highly diversified business model that sold, traded and saw most of the goods raised consumed here to a much more highly specialized model driven largely by national and global markets. By the end of the twentieth century, 24,600 supermarkets were responsible for 95 percent of all retail sales of food in the United States. The new food business model that consolidated production, processing, packaging, distribution and sales reduced food costs and provided a much greater diversity of products, but favored large-scale production that, for most commodities, has not been sustainable for Maryland farmers in competition with those in California, the Midwest and many other larger states.

The number of milk cows in Maryland at the end of the century was half the number of 1920. Maryland had lost its canneries and most of its mills. Acres in corn had dropped by a third and wheat had dropped by two-thirds. The number of hogs and pigs had declined drastically. Meanwhile, three million fewer acres of farmland were in production. Farmland losses also occurred in neighboring states and along the whole East Coast.

A few farm products in Maryland that benefited from proximity to urban population centers have found some success. Horticultural industries supply much of the landscaping materials for homes and businesses. The equine industry supplies pleasure horses and race horses for the region.

Two grain products, corn and soybeans, combined with a traditional animal product, poultry, to become a fully integrated, modern, large-scale operation: broilers and other meat-type chickens. This was Maryland's only true commodity growth industry by the end of the century and it continues to do well.

More recently, the local food movement is creating multiple opportunities for struggling farm operations to become profitable. These include direct and indirect sale of vegetables, fruits, meats, milk (and numerous value-added products) to local and regional consumers. The promise of such operations is based primarily on the growing markets for their products—suburban and urban populations, often (but by no means only) immediately around the farms. However, considerable obstacles remain, including a labyrinth of federal, state and local regulations and policies about health, food safety and land use, combined with the highly consolidated and nationalized production-to-marketing supply chain through which the vast majority of food reaches consumers.

At the landscape scale, from 1939 until 2012, counties that experienced greater reductions in farm acres primarily due to development tended to also experience greater decreases in agricultural economic rank, based on comparative total sales of agricultural products among counties. These counties also tended to have more rural land fragmented by large lot development; they also show the greatest shifts over that period of time away from livestock and toward nursery, greenhouse, horticulture, fruit and nuts, measured as percentages of agricultural sales from those respective products. These relationships between land in agriculture, fragmentation by large lot development, relative total agricultural sales, and shares of sales in large-scale livestock versus nursery, etc., appear likely to continue into the future.

In summary, the future of poultry and grain on the Shore remains promising. Nursery and horticulture should continue to thrive in service to developed and developing landscapes. The future appears reasonably stable for the equine industry. And the local food movement holds the potential for growth in production and direct and indirect local and regional marketing of fruits, nuts, vegetables, meats and value-added products. Projected land use changes (Chapter 3 and below), environmental regulations (Chapter 2 and below), and food safety and health regulations (Chapter 2 and below) will all play a role in defining what forms of agriculture will be sustainable in the future.

FORESTRY: As noted in Chapter 1, the 2.2 million acres of Maryland's forests in 1914 supported 3.8 billion board feet of timber, which in turn supplied an industry of 800 sawmills and 300+ wood-based manufacturers and ancillary businesses. 16,790 people relied on forest products for their wages, making it the second-largest single industry in the state. Loggers produced 229 million board feet of logs, 129 million of which were hardwood and 100 million were pine. Lumber accounted for 40 percent of the annual timber harvest, while 60 percent was processed into pulpwood, railroad ties, piling, cordwood (i.e., fuel wood), tanbark, staves, shingles, lath and charcoal. Today, there is even more capacity to produce wood products than at the beginning of the twentieth century, due to factors discussed in Chapter 1.

In 2013, there were still roughly 2.2 million acres of timberland, with the top ten timber species accounting for an estimated 22.5 billion board feet of saw timber, a resource that will be available for many years into the future. That volume increased by an estimated 5 percent between 2008 and 2013, indicating that the current harvest and natural mortality in Maryland's forests are being more than offset by growth.

Notwithstanding what appears to be the relatively constant total number of acres of forest since the early 1900s and a growing supply of timber and rate of annual production, fragmentation of existing forests by large lot development subdivisions remains the biggest single threat to the industry and to healthy forests. Large lot development means not only homes and lawns, but also roads, powerlines, and other landscape interruptions. Collectively, these interruptions reduce the size of contiguous forest tracts; create barriers to forest management and harvesting; create access avenues for invasive pests like Emerald Ash Borer and Gypsy Moth; and increase deer populations; all of which in turn change the composition of forests, reduce overall forest health, and compromise conditions necessary to sustain the forestry industry, which has declined significantly. In 2008, there were only 30 primary wood-processing mills in Maryland.

The point is that the primary obstacle for the industry is not a shortage of timber supply on the land; it is managing, accessing and harvesting the wood on increasingly small forest holdings by separate landowners adjacent to, or surrounded by, residential development.

A 2004 assessment of fragmentation impacts on Maryland's forestry industries that included case studies in six Maryland counties reported a recurring pattern of large subdivisions in which opportunities to retain large, manageable tracts of forest were bypassed. Forest lands instead were subdivided along with individual lots into very small holdings. Such fragmented woodlots—fragmented by both ownership and spatial barriers—have little or no value for management for commercial wood, firewood, recreation or wildlife.[54] The authors found that not acreage of forest but availability of harvests is a major constraint on the industry. Small parcels can be harvested, but the costs of buying the wood, organizing the harvest, obtaining permits and managing trucking are very high for small woodlots compared to large ones. Even though the supply in the form of standing timber is there, the cost of accessing and harvesting the wood reduces demand.

Timber harvests require permits, preparation of entrances and the movement of large equipment. The greater the number of residents, roads and development infrastructure in the forested landscape, the more objectionable these activities are likely to be to stakeholders not invested in forestry. The smaller the tract, the less feasible timber harvesting is from a physical, social and environmental standpoint. Currently, only about 58 percent of average annual growth is harvested. Desirable overstory composition is threatened as deer populations, enabled by food supply that increases with fragmentation, also increase and oaks and hickory decline as dominant species. Wildfire—a natural and renewing process in healthy forests—is controlled or eliminated where development intrudes into rural areas.

A few important opportunities stand out as potential parts of a sustainable future forestry industry in Maryland. Growing demand for wood energy provides a potential market for small diameter/low quality wood. Investment in existing utilization technology could make entire trees usable by markets, rather than the roughly one half of timber harvested that now goes to mills. Technology exists to create new structural wood products for which there is a growing market. If Maryland building codes are modified to use these products, such as cross-laminated timber, the industry could invest in their production within the state. One of the biggest potential markets—green building materials—not accessible to most Maryland forest landowners due to state policy governing their certification, may become accessible thanks to negotiations between the Maryland Department of Natural Resources, forestry interests and the Maryland Green Business Council, and recent actions by the council.

In summary, forest fragmentation notwithstanding, Maryland forests still produce large quantities of timber. If landowners have sufficient incentives for management, obstacles to harvesting can be addressed, and mills and other timber product consumers/users may have enough confidence in supply to invest. Investments in evolving processing and utilization technologies

will follow, and forestry should be sustainable for the foreseeable future in Maryland. But as the saying goes, that's a lot of "ifs."

4.2 Where (Geographically) and What Kinds of Farming and Forestry Might Be Most Affected by Land Use Changes and Recent Environmental and Land Use Policy Initiatives in Maryland, and Which Might Be Most Sustainable?

IMPACTS OF ENVIRONMENTAL REGULATIONS ON AGRICULTURE: Despite concerns that nutrient management and manure storage requirements would cause the ruination of farming and forestry in Maryland, our research and consultations suggest that farmers have been able to meet, or are in the process of meeting, their nutrient management regulatory requirements without widespread excessive losses of profits or agricultural businesses. This is not to say that the journey has been smooth or without casualties.

Farmers that will continue to experience the biggest impacts are livestock confinement operations. Dairies using confinement will have the biggest burden since virtually all of the regulations addressing nutrient management apply to them (e.g., PMT, incorporation, timing restrictions, setbacks, etc.). Those located on high phosphorus soils will have the most difficult challenges. Given that these pressures will increase at a time of decline for the industry, the regulations could well exacerbate the decline. Those most affected will likely be the middle-sized operations, between 400 and 100 cows, especially where additional manure storage is required.

The poultry industry will be the second most impacted agricultural sector. Farms, primarily in the Lower Shore, have been applying poultry litter on their fields for the longest time, and they will face the most challenges due to phosphorus management constraints. However, if projections coming from this report (see Chapter 2) turn out to be accurate, the transition should be feasible and the results both economically and environmentally sustainable.

IMPACTS OF ENVIRONMENTAL REGULATIONS ON FORESTRY: Nutrient management regulations have had little impact on the industry. Of greater importance are 1) state law that puts Maryland grown and processed wood at a market disadvantage compared to owners of larger tracts of woods in other states for green building materials, and 2) sediment and erosion control plans and logging permits for harvesting that are costly for owners of small woodlots, valid for a short time relative to forest management plans, and time consuming to complete relative to the windows of opportunity available for harvesting in many areas, especially during winter. These impacts are felt throughout the state.

DEVELOPMENT, LAND USE POLICY AND THE IMPACTS ON AGRICULTURE AND FORESTRY: As discussed in Chapter 3, our analysis of future land use change may over- or under-estimate what will actually occur in specific places, by region and statewide. That said, we believe that the estimates are good indicators of what is likely to occur unless development markets, land use management plans and programs, or both, change substantially over the next 25 years in comparison to current plans and markets over the past two decades. There are many ways in which both may change, but no definitive data to indicate how much, where and when.

With these limits in mind, our analysis indicates that impacts of more intrusive residential development are likely to occur in parts of all six regions of the state:

- Livestock industries in parts of Western, Central and Eastern Shore Maryland may be threatened or compromised by continued fragmentation of rural land by residential subdivision and development. These risks appear greatest in parts of Washington, Frederick, Harford, Cecil, Queen Anne's, Caroline and Wicomico counties. Enough land will remain in all three regions to continue

to support these industries, but under compromised conditions and constraints discussed in Chapter 3.

- While not a forgone conclusion, our findings suggest that the grain-poultry-processing system on the Eastern Shore will remain sustainable, i.e., farmers and integrators will remain profitable and water quality concerns will be adequately addressed over the long term. A threat to this balance is development, which may fragment and compromise large blocks of working land harboring both poultry production facilities and the cropland on which the former depend. Losses of significant grain acreage would compromise the ability to provide feed for and dispose of litter from production, in addition to the usual impacts of increased neighbor-farmer friction, and may also further the loss of support services that farmers rely on for seeds, equipment, credit and technical assistance.
- Trends of the last 75 years away from industrial-scale livestock and crop production towards nursery, greenhouse, fruits, vegetables and alternative production geared toward emerging markets for locally produced food, are likely to continue everywhere in the state. We say this both because fragmentation by residential development continues to erode the rural environment necessary to sustain livestock and large scale commodity production, and because markets for locally, regionally and more naturally produced food (in the eyes of consumers) are growing, providing the opportunity for small scale, diverse, value-added farming and marketing that may be increasingly profitable.
- Forest industries may be compromised in parts of Southern Maryland, the Lower Eastern Shore, Central Maryland and Western Maryland, in decreasing order of the magnitude of potential impacts on the types of timber and markets in those regions.
- Smart growth tools, primarily manifest through local comprehensive plans, zoning, development rules, and preservation programs, are helping enormously to limit these impacts in areas where they are most rigorously practiced. The magnitude of residential development market demand—how many people and families are in need of housing, and particularly how many of them seek larger lots in suburban or rural locations instead of more concentrated forms in areas with existing infrastructure—is also a factor of paramount importance. But both past patterns of residential development and small-area forecasts for future growth strongly indicate that where rural zoning is more protective—allowing subdivision of fewer lots for a given number of acres—residential markets have been and will continue to be deflected away from agricultural and forested lands to areas planned for denser development. For this purpose, the more restrictive the zoning the better—for example, within a given real estate market, one lot per 50 acres will be more effective for this purpose than one lot per 30 acres, which in turn will be more effective than one lot per 10 acres.

Based on completed studies and our analysis, the effects of the "Septics Bill"—the Sustainable Growth and Agricultural Preservation Act of 2012—will primarily be to reduce subdivision capacity in Tier IV areas, dispersing development more broadly in those areas sooner than might have occurred without the act, and ultimately reducing the number of potential residential lots in those areas at "build out"—i.e., when all the allowable lots have been subdivided and built under existing zoning and subdivision limits. The degree to which these limits result in residential populations compatible with farming and forestry depends primarily, as it did before the act, on local zoning. Accordingly, the effects of the Septics Bill should be considered supplemental to zoning, and not an effective surrogate for it.

4.3 How Might Public Policies Be Adapted to Minimize Negative and Maximize Positive Effects of Bay Restoration, Smart Growth Initiatives, and Important Externalities on the Sustainability of Farm and Forest Production and Marketing Options?

In using the term "public policies" here, we are referring to policies implemented through regulations; coordination among agencies, levels of government and the private sector; education and outreach to better connect industries, government and the public; and incentives programs. These are not necessarily separate and distinct areas of activity, but provide a useful framework for discussion.

4.3.1 Regulation

Sometimes, regulation is needed. The United States succeeds with the freedoms and opportunities it provides, but its founders also recognized that citizens have responsibilities too, and that regulation is needed for the common good, including protection of the commons—our land, air, water and natural resources that are publicly "owned."

Zoning and health regulations are viewed in two ways. Some say that they are needed for the health, safety and welfare of citizens; others view them as infringements on property rights and personal freedoms.

Bad, out-of-date and inappropriately scaled regulations can impede prosperity. If Maryland policy makers wish for agriculture and forestry to succeed, they will continue to monitor and revise regulatory strategies to enable the industries to prosper as conditions change, minimizing them wherever possible to maximize the freedoms and opportunities side of the equation.

A common fear and rallying cry of any business community faced with new regulation is that it will cause a widespread loss or demise of businesses. This study posed this question directly to farm industry experts and farmers and examined available data for corroboration.

Based on our findings (Chapter 2), nutrient management regulations have had significant impacts on time, costs and management, and have caused headaches and no small amount of social friction among Marylanders. Some of these factors undoubtedly contributed to individual farmers and farm families leaving the business, and the trend toward farm consolidation and associated loss of middle-sized farms. But our findings suggest that other factors were more important, including national trends toward food supply chain consolidation, specialized production and larger operations, leaving Maryland farmers at a disadvantage when facing spreading development and dwindling supplies of land, in what is a small state to begin with. Most negatively affected by these trends and regulatory processes has been the livestock sector, especially dairy, as we have noted elsewhere.

We found little evidence or support from stakeholders for the idea that significant numbers of farms were driven out of business primarily due to regulations. In fact, many positive outcomes were identified by stakeholders: improved management and efficiency, better environmental stewardship, and leveling the playing field within the industry for example. Maryland leads other Bay states in lowering nutrient and sediment loads. According to Lynne Hoot, of the Maryland Grain Producers Association, responding to conservation requirements has led Maryland "to have the smartest farmers." A bullish sentiment about the future of agriculture was reflected in the presentations at the Eastern Shore Land Conservancy's *Future of Eastern Shore Agriculture Conference* held in Easton on November 20, 2014. Climate change, rising sea levels and encroaching suburban development received more attention than regulatory challenges.

One very positive step concerning regulation has been the establishment in 2011 of the Maryland Agricultural Law Education Initiative by the Maryland General Assembly. Since then,

university attorneys have been churning out guides and resources to help farmers address the legal issues with regulatory compliance and other public policies that comprise agriculture law. They have also been holding workshops and webinars throughout the state.

▸ RECOMMENDATIONS

Below, we suggest actions that could prove effective in supporting the health and resilience of the agricultural and forestry industries within the regulatory environment.

AGRICULTURE

For the new phosphorus management regulations:

1. Ensure that a Phosphorous Management Tool Transition Advisory Committee (comprised of government, university, farmers, manure haulers, alternative use industries, biosolids and environmental interests) is established and carries out its task outlined in the regulations to evaluate the infrastructure and capacity available to manage additional manure as farmers transition to the PMT.
2. Ensure that economic impact studies of new regulations are carried out using the monitoring data to estimate costs and benefits.

To better support livestock farmers, especially dairy farmers:

1. Continue financial assistance for manure storage and transport.
2. Consider introducing greater regulatory flexibility to allow fall/winter manure application based on local soil and weather conditions.

To address obstacles to direct market access identified by industry representatives interviewed for this project, a group of public/private stakeholders should convene to identify improvements to zoning and health and food safety regulations that would better support value-added processing and direct marketing of animal, fruit and vegetable products and foods in Maryland and the region. Specifically, the group would develop models and guidelines to help implementing public and private sector partners:

1. Modify zoning regulations to give farmers flexibility to produce and direct market value-added products (e.g. cucumbers to pickles, milk to cheese, grapes to wine, wheat to bread flour, timber to locally sourced lumber, etc.).
2. Modify health and food safety regulations to give small farmers the ability to process, add value to, and direct market meat, fruit and vegetable products to local and regional consumers and other markets while effectively protecting food safety and public health. This means size-of-operation appropriate recommendations for relevant regulatory processes.
3. Identify and address issues blocking expansion of on-farm value-added and direct market products arising from neighbor objections and zoning regulations.
4. Identify and address labor shortage issues.

FORESTRY

A group of public/private stakeholders should convene to identify and take steps to:

1. Minimize obstacles to harvesting, particularly on small, privately owned woodlots and during the short windows of opportunity for harvesting in the winter and other wet periods. Among options to be explored should be better integration of forest management planning, sediment and erosion control, and logging permits that may differ among local governments.
2. Maximize access to green building markets by private owners of small woodlots in Maryland. Build on steps taken thus far by Maryland's Green Building Council to recognize forest certification systems affordable to these owners.

4.3.2 Coordination, Education and Outreach, and Incentives Programs

Most USDA publications emphasize scale as key for future success of agriculture in the U.S. The bigger the operation, the more likely it will succeed. At this time, Maryland can point to one successful effort at achieving sufficient scale and integration: broilers. As described in Chapter 1,

success was not confined to one state. The broiler industry began in Delaware and quickly spread to neighboring states. Extension and the departments of agriculture have fostered interstate cooperation and facilitated its growth. With the way that states along the East Coast are bifurcated by waterways and mountain formations, it only makes sense for them to work together.

Cooperatives and food hubs can be another way to scale up. The dairy industry has prospered over the decades by working with cooperatives. Such aggregation allows them to produce at a scale to supply some regional and national food chains. Food hubs are proving to be an effective tool for other types of agricultural production. Small and mid-size farms are able to scale up to reach institutional markets while farmers markets and CSAs give them access to retail markets willing to make the effort to select and buy from their own farmers.

Even if every Maryland product is not competitive in all global markets, farmers can still be successful if mechanisms are in place for direct and indirect sales of products to Maryland residents and neighboring states.

▸ RECOMMENDATIONS

AGRICULTURE

Maryland's last comprehensive strategic plan for agriculture was developed at the end of Governor Ehrlich's term. An update and assessment was conducted in the early years of the O'Malley administration.

We recommend that the current governor commission a new strategic visioning exercise to create an updated plan that addresses some critical needs identified by stakeholders contributing to this study. Specifically, commission an intergovernmental, public/private sector strategic planning group that includes state agencies, the Extension Service and land grant universities, and farmers, processors, distributors and other businesses that support the agricultural industry to:

1. Improve support for production and marketing to national/global markets and for direct and indirect marketing locally and within the Chesapeake Bay region.
2. Address product development, marketing, adaptation to climate change, trade agreements, and needed research and education to identify and support strategies that will meet needs for new farmers and labor.
3. Coordinate strategies with neighboring states.
4. Determine how to best foster improved connections between farmers and residential communities through strategic education and outreach programs. Build on examples of such programs currently conducted and pioneered by organizations like the Maryland Cooperative Extension Service, Maryland's Agricultural Commission, and the Maryland Agricultural Resource Council in collaboration with their numerous partners.
5. Monitor and measure implementation of the plan and its outcomes in the industry and rural communities.

FORESTRY

The forest industry in Maryland could also benefit from a strategic plan, specifically to address major obstacles to the sustainability of the industry and to better support utilization of timber production. The planning efforts should engage forest landowners, loggers, mills and wood product manufacturers, in addition to state agencies and resource economists. Objectives should include:

1. Reduce impediments to forest management and logging on the increasing number of small, privately owned woodlots;
2. Improve access of small woodlot owners to markets for a broader diversity of wood utilization processes and techniques;
3. Increase the stability of timber supply from small woodlots for mills and other users of timber products;
4. Encourage business development of in-state facilities to implement more diverse utilization technologies; and
5. Support development and implementation of wood energy and other technologies to more fully utilize Maryland's timber production, such

as those described for products and markets from wood wastes and residues by New West Technologies, LLC of Landover, MD in their 2008 report.[55]

6. Fragmentation of forestland by residential development is a major source of negative impacts on the forest industry, and it is expected to continue and intensify throughout the state. Accordingly, develop strategies to foster mutually supportive relationships between forest landowners who want to grow and harvest timber and the neighboring public in an increasingly fragmented forest landscape.

4.3.3 Land Use and Land Preservation

As discussed elsewhere in this report and commonly understood by many, it is difficult to farm or harvest timber in a suburbanizing region. All agricultural and forestry operations need sufficient space to operate equipment and make appropriate noise, generate appropriate smells and harvest appropriate plants, trees or animals. Large blocks of land are required except for the smallest operations, which fortunately are appropriate for some of the emerging agricultural markets. Retention of larger blocks of woods and fields in rural areas means land is less expensive and problems between neighbors are diminished.

Encroachment of residential subdivisions has led to difficulties ranging from inconvenience to active attempts to constrain farm and forestry activities. Maryland's right-to-farm laws and the Agricultural Conflict Resolution Service offer avenues for protection and assistance for farmers. Social acceptance of farming practices may grow as more consumers develop relationships with farmers who produce their food and with foresters who grow and harvest wood products. Some of these conflicts between residents and farm and forest business might be addressed through the kinds of education and outreach efforts mentioned above for both agriculture and forestry in section 4.2.2. But it is far simpler for all parties when resource managers have sufficient space and don't have to deal with complaints from their neighbors. And for issues like the necessary balance between grain production, poultry feed, and litter disposal that essentially rely on fairly extensive acreage further constrained by phosphorus considerations, minimizing development and conversion of land is essential.

Retention of large extents of farms and forests in Maryland require both protective zoning and successful preservation (easement acquisition) programs. Zoning enables counties to set priorities for how portions of county land will be utilized and protected from development for farming and forestry. Large extents of preserved private land create stability for landowners and resource utilization businesses. If either protective zoning or timely land preservation programs are missing, and there is a substantial market for rural residential development in a region, the land becomes too fragmented by development before easement acquisition programs—including state, local and transferable development rights programs—can preserve enough of the land to achieve the desired outcome.[56] In short, it's only a matter of time until market demand outraces preservation, unless there's concerted effort from land use planning and management on the one hand and land preservation on the other.

The report cited in the preceding paragraph—*Maximizing Return on Public Investment in Maryland's Rural Land Preservation Programs*—makes a series of recommendations to better integrate land use and preservation tools that have been implemented to varying degrees by several state and local preservation programs. A more recent report—*Preserving Sustainable Resource Lands*[57]—consolidates information about, and recommendations from, 28 plans and studies related to the sustainability of agricultural and forestry resources in Maryland that should also be considered.

The Septics Bill—more properly the Sustainable Growth and Agricultural Preservation Act of 2012—attempted in part to address this issue by requiring consistency between local comprehensive plans, the intent of zoning ordinances, mutual state/ local designations of priority areas for preservation, and permitting for waste water treatment. Based on our assessment

of the results, the act is helping to limit continuing fragmentation of rural lands to a degree, but only in context of existing local zoning (see Section 4.2 above and Chapter 3 for more information).

In short, limits on development and its impacts on agriculture and forestry rely primarily on local priorities for rural resource land and industries. Those priorities are established in the local comprehensive plan and, most importantly, implemented and supported by zoning ordinances, subdivision and development regulations, state and local preservation programs, and land use decisions of local governing bodies.

To support sustainable farming and forestry, it is clear additional improvements are needed in the ways that land use is managed and preservation programs are protecting resource lands. Efforts over the last 20 years have made incremental progress, but not enough to stabilize the land use playing field for rural resource industries. In addition to those referenced above from previous studies, other options should be explored.

For example, particularly for the forest industry, the possibility should be examined that subdivision and development rules might be modified by a local government and used, in tandem with the local forest conservation program, to retain larger forested tracts instead of dividing them into small woodlots distributed among individual lot owners, reducing or eliminating their ability to support timber harvests. If, through this means, average sizes of retained woodlots could be increased considerably, and such an approach was used widely in a region or county, it might make the difference between an inaccessible timber supply and one that is available and capable of sustaining a mill, manufacturing operation or other utilization business.

This is the type of locally customized strategy we recommend more generally in the next section.

4.3.4 Integrating Public Policy and Private Sector Investment

It may be evident from the preceding discussions that sustainability of agriculture and forestry in Maryland depends on many things. These include evolving external market, economic and technological factors and some of the public policies explored herein. Less evident may be the fact that sustainability also depends on the degree to which these factors and policies come together—confluence if you will—with private sector plans and investments in specific geographic areas. The policies are typically aimed at public objectives; for example, water quality has been a focus in this report. Private sector investments are aimed at profitability, competition and markets.

A good example of this need for confluence in the agricultural sector is commodity-scale poultry on the Eastern Shore. Its future may depend in part on limiting further impacts of development, and in part on continued evolution of nutrient management policy in ways that support profitability while adequately limiting pollution. Impacts of development include a) residential neighbors that compromise production and litter disposal on cropland in a variety of ways, and b) conversion of remaining cropland to levels that might be insufficient to produce adequate feed, dispose of poultry litter, and avoid the need to import feed from other regions and transport litter to the Western Shore.

Future investment of the poultry industry on Maryland's Eastern Shore, as opposed to Delaware, Virginia or other states, depends on what investors see happening to land resources, development impacts in the surrounding environment, and on the regulatory playing field in each geographic location. If land use and environmental policies don't support the industry in one location, integral parts of industry—production farmers, grain producers, litter applications sites, processing facilities—will falter, and the industry will invest in another location with more favorable conditions.

This example illustrates the need for a geographic-specific confluence between farmers, other industry stakeholders, counties with land use management authority (in this example, on the Shore), and relevant environmental policies. It is important because anticipated return on future industry investment will depend on reasonable expectations about land use, the ability to produce and process birds and bird feed and dispose of litter, and the environmental regulatory playing field.

As population and development continue to expand quantitatively and geographically, this kind of confluence between private objectives and public objectives becomes increasingly essential for many other sectors of the agricultural and forestry industries. In the absence of deliberate confluence, the industries can only react to what happens in the landscape and marketplaces around them. Under that scenario, the sustainability of some industry sectors may be compromised or lost in some parts of the state, as has already occurred with livestock and logging in much of central Maryland up until now. Exactly what will happen where is anybody's guess, but Chapters 3 and preceding sections of this chapter suggest some possibilities.

If there is an over-arching recommendation indicated by the findings and conclusions of this report, it is that Maryland's public policy should evolve explicitly both to achieve public objectives of interest and to inform and support private sector investment in these two industries, through collaborative process.

ENDNOTES

1. Middleton, Arthur Pierce. *Tobacco Coast, A Maritime History of Chesapeake Bay in the Colonial Era.* The Johns Hopkins University Press. 1953.
2. Levinson, the Great A&P.
3. Ellickson, Paul. *The Evolution of Supermarket History: from A&P to WalMart.* 2015.
4. Blayney, Don P., *The Changing Landscape of U.S. Milk Production,* USDA ERS 978.
5. Dimitri, Carolyn et al, *The 20th Century Transformation of U.S. Agriculture and Farm Policy,* USDAERR 3. p. 10.
6. Jeffrey Ferris and Lori Lynch, "The Impact of Agriculture on Maryland's Economy," University of Maryland Center for Agriculture & Resource Policy, April 2013, p. 1.
7. "The Birth of an Industry," Chapter 1, www.dpichicken.org.
8. Williams, William. *Delmarva's Chicken Industry: 75 Years of Progress, Delmarva Poultry Industry, Inc.,* 1998. p. 26.
9. J. C. Hanson ,1 D. M. Johnson, E. Lichtenberg , and K. Minegishi, *Competitiveness of management-intensive grazing dairies in the mid-Atlantic region from 1995 to 2009,* American Dairy Science Association, Journal of Dairy Science Vol. 96 No. 3, 2013.
10. Kays, Jonathan. *Maryland's Forests: Past, Present, and Future.* Maryland Cooperative Extension.
11. Lister, T.W. and S.A. Pugh. 2014. *Forests of Maryland, 2013.* Resource Update FS-24. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.
12. Maryland DNR Forest Service, *Maryland's Forest Industry – a Pillar of Our Economy and Quality of Life,* July 26, 2012. p. 7.
13. Ibid, p 2
14. MacDonald, James M., Penni Korb, and Robert A. Hoppe. *Farm Size and the Organization of U.S. Crop Farming,* ERR-152. U.S. Department of Agriculture, Economic Research Service, August 2013.
15. Hoppe, Robert A. *Structure and Finances of U.S. Farms: Family Farm Report, 2014 Edition,* EIB-132, U.S. Department of Agriculture, Economic Research Service, December 2014.
16. Ibid, p. 49
17. "The State of Maryland Agricultural Outreach Plan," State of Maryland Department of Labor, Licensing and Regulation. p. 4.
18. Walthall, C.L., et.al. *Climate Change and Agriculture in the United States: Effects and Adaptation.* USDA Technical Bulletin 1935. Washington, DC. p. 9.
19. Ibid. p. 27
20. Maryland Commission on Climate Change, "Interim Report to the Governor and the Maryland General Assembly: Climate Action Plan" (2008) p. 2. The report is available at www.mde.state.md.us.
21. Wolman, M. Gordon. "Water for Maryland's Future: What We Must Do Today." Maryland Department of the Environment. July 2008. p. 10.
22. Martinez, Steve, et al. *Local Food Systems: Concepts, Impacts, and Issues,* ERR 97, U.S. Department of Agriculture, Economic Research Service, May 2010. p. 2.
23. Low, Sarah A., Aaron Adalja, Elizabeth Beaulieu, Nigel Key, Steve Martinez, Alex Melton, Agnes Perez, Katherine Ralston, Hayden Stewart, Shellye Suttles, Stephen Vogel, and Becca B.R. Jablonski. *Trends in U.S. Local and Regional Food Systems,* AP068, U.S. Department of Agriculture, Economic Research Service, January 2015. p.2
24. Southern Maryland Agricultural Development Commission. "Existing and Emerging Food Hubs in Maryland." September 15, 2014.
25. U.S. Department of Agriculture Foreign Agricultural Service, www.fas.usda.gov/sites/default/files/2014-07/tpa-maryland.pdf.
26. NAFTA at 20: *North America's Free-Trade Area and Its Impact on Agriculture, WRS-15-01* Economic Research Service/USDA. P. 8.
27. Spencer Phillips and Beth McGee, *The Economic Benefits of Cleaning Up the Chesapeake: A Valuation of the Natural Benefits Gained by Implementing the Chesapeake Clean Water Blueprint,* Chesapeake Bay Foundation, October, 2014, p.1.
28. *Chesapeake Bay Agreement 1987,* p. 2.
29. Paul L. Sorisio, "Poultry, Waste, and Pollution: the Lack of Enforcement of Maryland's Water Quality Improvement Act," 62 Md. L. Rev. (2003), p. 1061.
30. Perez, M. (2010). *Does the policy-making process affect farmer compliance? A three-state case study of nutrient management regulations.* Ph.D. dissertation. College Park, MD: University of Maryland.
31. Chesapeake Bay Agreement 2000, p. 6.
32. "Settlement Agreement, Bernard Fowler, et al. vs. United State Environmental Protection Agency," May 10, 2010.
33. Maryland Nutrient Management Law, §8–801 to §8–807.
34. Erik Lichtenberg, Doug Parker and Chad Lawley. *Does it Matter Who Writes Your Nutrient Management Plan? Evidence from Voluntary Nutrient Management Plans in Maryland.* Research Brief, Center for Agricultural & Natural Resource Policy, University of Maryland. 2012
35. *Agriculture and Water Quality on the Maryland Eastern Shore: Where Do We Go from Here?* Kenneth W. Staver and Russell B. Brinsfield. October 2001/Vol.51 No. 10 • BioScience, p. 46.

36. Mary Owens, Editor. *Bay Smart, A Citizen's Guide to Maryland's Critical Area Program, Critical Area Commission for the Chesapeake and Atlantic Coastal Bays,* p. 6.

37. Ferris, Jeffrey and David Newburn. 2016. "Additionality and forest conservation regulation for residential development." Working paper, University of Maryland, p. 41.

38. Erik Lichtenberg and Ian Hardie, 2007. Open Space, Forest Conservation, and Urban Sprawl in Maryland Suburban Subdivisions. Amer. J. Agr. Econ. 89 (Number 5, 2007): 1198–1204.

39. The Maryland Dairy Industry Oversight and Advisory Council, Maryland's Dairy Industry: 2013, *A Report to Governor Martin O'Malley.* January 2014, p. 11.

40. Steve Martinez, et al. *Local Food Systems, Concepts, and Issues, Local Food Systems: Concepts, Impacts, and Issues, ERR-97.* Economic Research Service/USDA, p. iii.

41. Mark Levinson, *The Great A&P and the Struggle for Small Business in America,* Hill and Wang, 2011, p. 250.

42. http://ilsr.org/what-new-census-data-show-about-state-independent-retail.

43. Martinez, et al., p. 41.

44. http://ilsr.org/what-new-census-data-show-about-state-independent-retail.

45. Erik Lichtenberg and Elina Tselepidakis, "Prevalence and Cost of On-Farm Food Safety Measures in the Mid-Atlantic," Department of Agricultural and Resource Economics, University of Maryland, College Park, July 2015.

46. Martinez, Steve, et al. *Local Food Systems: Concepts, Impacts, and Issues,* ERR 97, U.S. Department of Agriculture, Economic Research Service, May 2010, page 27.

47. Ibid, p. 27

48. www.nichemeatprocessing.org/wp-content /uploads/2014/09/Expanded-Directory-of-Facilities-in-Maryland.pdf

    www.southernmarylandmeats.com /USDAProcessingFacilities.pdf

49. Peter Downs, "Green Building Movement a Boon for American Industry," St. Louis Post-Dispatch (online), February 12 2015.

50. Peter Downs, *Green Building Movement a Boon for American Industry, St. Louis Post-Dispatch,* February 12, 2015.

51. Mark Ribaudo, *Managing Manure: New Clean Water Act Regulations Create Imperative for Livestock Producers,* USDA Amber Waves, February, 2003.

52. Low, Sarah A., and Stephen Vogel. "Direct and Intermediated Marketing of Local Foods in the United States," ERR-128, U.S. Department of Agriculture, Economic Research Service, November 2011. p. iii.

53. 2013_reducingpollution_031414final (Final Tab Indicator Loads-Goals 031414

54. Lloyd C. Irland, 2004. Forest Production, Industry and Forest Retention Assessment. Maryland Center for Agro-Ecology Publication 2004-01.

55. bid

56. Tassone J and E Balsley, L Eisenberg, S martins and R Hall. 2004. Maximizing Return on Public Investment in Maryland's Rural Land Preservation Programs. Maryland Center for Agro-Ecology Publication 2004-05.

57. Dehart H. G. 2011. Preserving Sustainable Resource Lands, A Summary of Plans and Studies Related to the Sustainability of Agricultural and Forestry Resources in Maryland. Maryland Center for Agro-Ecology Publication 2011-06.

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