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Your Land, Your Water: Using Research to Guide Conservation Practices on Local Farms in the Chesapeake Bay Watershed

Agricultural lands are an important part of the economy and heritage of the Chesapeake Bay watershed and are a focus of conservation activities. Streams and rivers around farms provide communities with drinking water and recreational opportunities, but these local benefits can be impaired by elevated nutrient and sediment concentrations. Compared to inputs from the atmosphere, wastewater, and urban and suburban areas, agricultural lands are the largest source of nutrients and sediment in many Chesapeake Bay streams.

Farmers are voluntary conservation partners and have an important role in improving water-quality conditions. This fact sheet summarizes recent scientific insights from the U.S. Geological Survey (USGS) that can help farmers use conservation practices and their knowledge of local site conditions to achieve cleaner water.

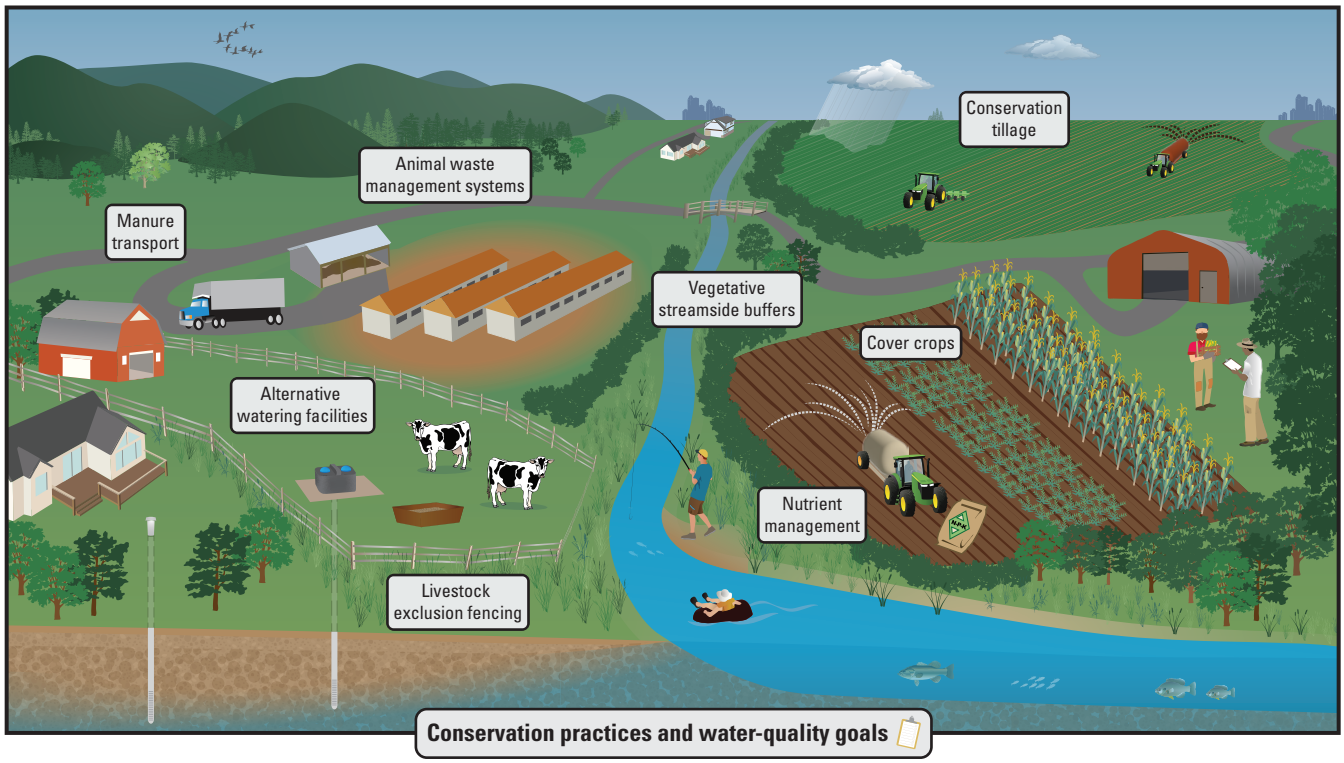


Figure 1. Illustration showing common conservation practices that are expected to reduce nutrient and sediment loads in the Chesapeake Bay watershed.

Q: How have agricultural activities and conservation practices changed over time?

A: Since 1985, agricultural land area decreased, the intensity of crop and animal production increased, and the use of conservation practices increased.

Agriculture represented about one-quarter of land use in the Chesapeake Bay watershed in 1985 and has decreased through 2020. Despite this decrease, the intensity of agricultural animal and cropland activities has increased in many areas, particularly in the Shenandoah Valley region of Virginia and West Virginia, southeastern Pennsylvania, and throughout the Delmarva Peninsula. Increased poultry populations resulted in more manure produced and applied in the watershed. Fertilizer applications were generally lower in 2020 than 1985 but amounts varied between years and locations. The amount of land with conservation practices was nearly five times larger in 2020 than 1985. This increase in conservation practices is expected to reduce nutrient and sediment loads by millions of pounds.

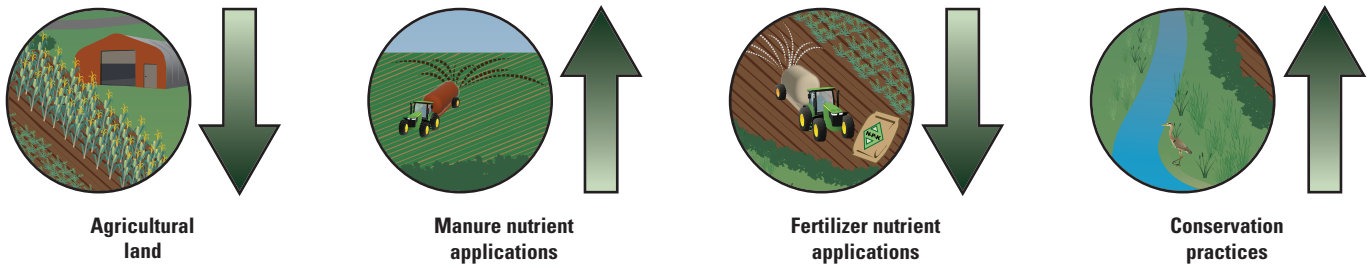
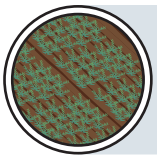


Figure 2. Generalized changes in agricultural land area, nutrient applications, and conservation practices from 1985 through 2020 in the Chesapeake Bay watershed (Chesapeake Bay Program, 2020).

Q: Have conservation practices improved water-quality conditions?

A: Studies on farms and fields have shown that conservation practices can reduce nutrients and sediment in streams; however, expected reductions are not always observed in larger watersheds.

The water-quality benefits of conservation practices can be apparent in some local settings. Here are some examples that demonstrate the importance of using conservation practices on a farm to provide clean water.



Cover crops can reduce soil erosion and decrease the movement of nitrogen to groundwater.

Buffers can reduce sediment carried to streams in runoff and nutrients delivered to streams from groundwater.

The combined effects from a system of conservation tillage, nutrient management, and other cropland management practices can reduce nutrient loads.

Expected nutrient and sediment load reductions from conservation practices can vary widely. In general, expected conservation-practice effects are evaluated from field-scale and plot-scale studies and are not observed in water-quality responses monitored from larger watersheds (Webber and others, 2021). Agricultural and scientific communities are working together to learn more about the water-quality effects of conservation practices.

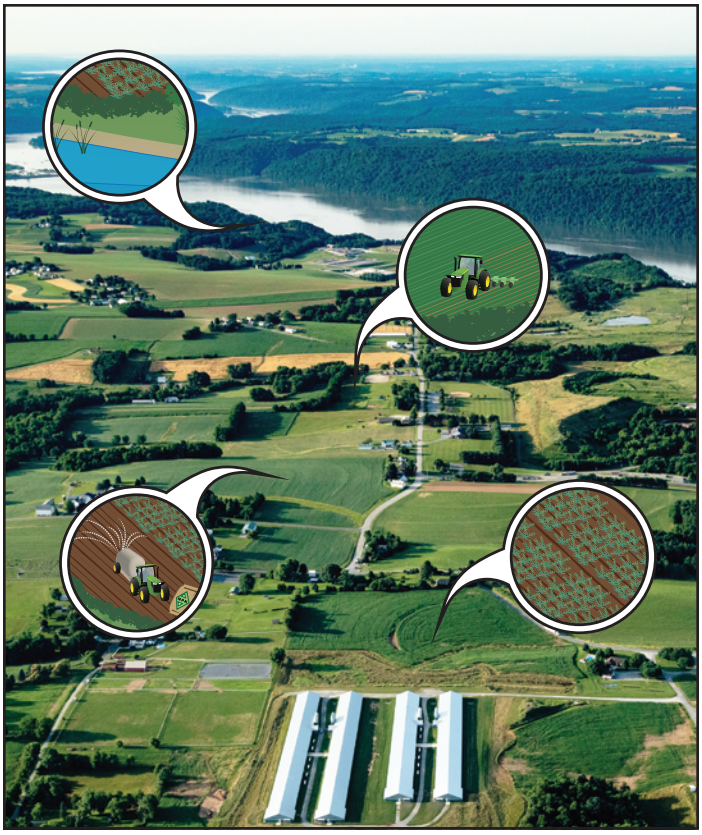
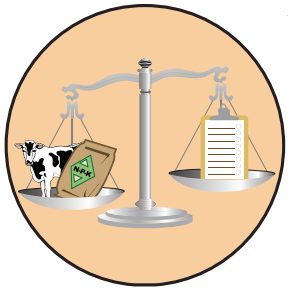


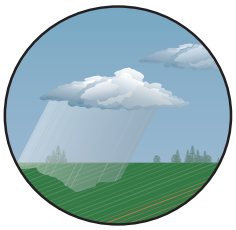
Figure 3. Photograph of farmland in the Susquehanna River watershed, with conceptual locations of conservation practices. Photograph by Will Parson, used with permission.

Q: What are the challenges to improving agricultural water-quality conditions?

A: Expected conservation-practice load reductions can be overshadowed by increasing manure and fertilizer nutrient applications and changing weather patterns.



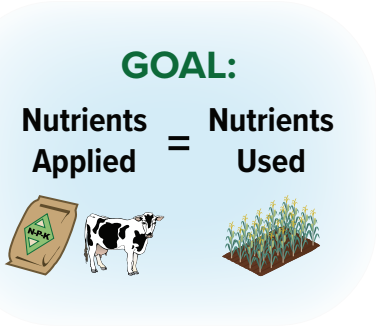
Increases in manure and fertilizer use may overshadow some expected load reductions in streams. Surplus nutrient applications (applications that exceed crop needs) have increased in recent years. Nutrient loads may not decrease in streams until surplus nutrient applications are reduced. Even then, water-quality conditions may be slow to change because of nitrogen in groundwater and phosphorus in soils that were contributed by past agricultural activities. Nutrients in groundwater and soils can take a long time to reach streams so it can take years to reduce these legacy nutrients.



Changing weather patterns can have complex effects on streamflow and water quality. Rainfall can differ seasonally, with droughts in some months and floods in others. Although weather patterns differ from year to year, recent years have generally been warmer and wetter. Nutrient and sediment delivery to streams is greater in wetter years. Warmer and wetter years can change the amount of nutrients stored in soils, nutrients removed by plants, or nutrients that are needed for agriculture. These climatic changes can alter the effectiveness of some conservation practices and are important to consider when planning conservation practices.

Q: What are the characteristics of effective conservation practices?

A: Effective conservation practices balance nutrient applications with crop needs and are customized to local site conditions.



Effective conservation practices adjust the source, method, rate, and timing of nutrient applications to match crop needs. Soil tests can help determine the amount of additional nutrients needed for crops. Conservation practices that prevent an overapplication of nutrients can reduce fertilizer costs and protect clean water on a farm.

Effective conservation practices are adapted over time to address local nutrient and sediment conditions on a farm. Practices in animal-production areas that manage manure and practices in crop-production areas that prevent excess fertilizer applications can lower nutrients in streams. Practices that reduce streambank erosion (an important sediment source in small streams) can help lower sediment in streams. Effective conservation practices also prevent clean water from reaching polluted areas and control the delivery of nutrients and sediment to streams during high streamflow conditions.

Nutrient and Sediment Management in the Smith Creek Watershed

The Smith Creek watershed in Virginia's Shenandoah Valley is an area of focused conservation and water-quality monitoring. In Smith Creek:

- Manure is a major nutrient source to streams (Webber and others, 2021). Therefore, conservation practices that address the method, rate, and timing of manure applications may help reduce nutrient loads.
- Streambanks are a major sediment source to streams (Gellis and Gorman Sanisaca, 2018). Therefore, conservation practices that address streambank erosion may help reduce sediment loads.
- Continued water-quality monitoring can help assess water-quality conditions and conservation-practice effects.

Figure 4. Photograph of a restored stream reach in the Smith Creek watershed. Photograph by Virginia Natural Resources Conservation Service (NRCS), used with permission.

Q: What other opportunities can improve and assess conservation-practice effects?

A: A system of conservation practices targeted to high-loading areas can help reduce nutrient and sediment loads. Water-quality monitoring is critical to assess conservation-practice effects.

- **A system of conservation practices** that address multiple sources and delivery pathways may provide greater load reductions than the use of individual practices (U.S. Environmental Protection Agency, 2018).
- **Targeting conservation practices** in areas that can potentially deliver large amounts of nutrients and sediments to streams could be a cost-effective approach that improves water-quality conditions.
- **Precision agriculture and other new technologies** have the potential to better align nutrient applications with crop requirements, which can reduce excess nutrients and improve water quality (Clune and others, 2021).
- **Water-quality monitoring** provides an accurate representation of local water-quality conditions that can guide and assess conservation practices. Additional long-term monitoring studies in small, highly managed agricultural watersheds are needed to assess water-quality responses and conservation-practice effects.

Figure 5. A USGS technician collects a water-quality sample. Photograph by Will Parson, used with permission.

Q: What resources can help with assessing and planning effective conservation practices?

A: Scientific insights can be used to evaluate the effects of conservation practices on water quality. Technical specialists can help farmers plan and implement conservation practices.

- The USGS summarizes scientific insights about water-quality responses to help evaluate conservation-practice effects. For more information, please visit: https://usgs.gov/SIMPLE
- The USGS works with federal, state, and local technical specialists to help farmers plan and implement effective conservation practices. This collaboration and continued stewardship of the land by farmers can provide cleaner water for farms, families, and the Chesapeake Bay.

For more information about USGS Chesapeake Bay science, please visit: https://usgs.gov/centers/cba

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