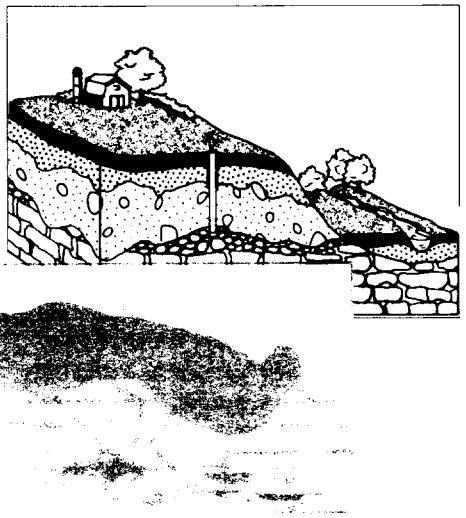

Soil Facts

Agriculture and Coastal Water Quality

Water quality is an important issue in coastal North Carolina. In 1989, the North Carolina Division of Environmental Management (DEM) estimated that at least 40 percent of the streams that flow into the Albemarle-Pamlico estuary have been degraded by nonpoint-source pollutants (Figure 1). That percentage represents 3,600 miles of streams.

Degraded streams cannot support (or can only partially support) their original functions. Many are unsuitable as sources of drinking water; others will no longer sustain certain forms of marine life; still others have become unattractive to recreational users.

The DEM study indicates that nonpoint-source pollutants cause over 96 percent of the stream degradation in North Carolina. Agriculture is responsible for over 67 percent of that total, a figure equivalent to 2,400 miles of streams (Figure 2).

The DEM study also indicates that 7 percent of the Albemarle-Pamlico estuary's 1,867,500 acres are incapable of supporting their original functions. Agricultural nonpoint-source runoff was blamed for 65 percent (83,037 acres) of that total (Figure 3).

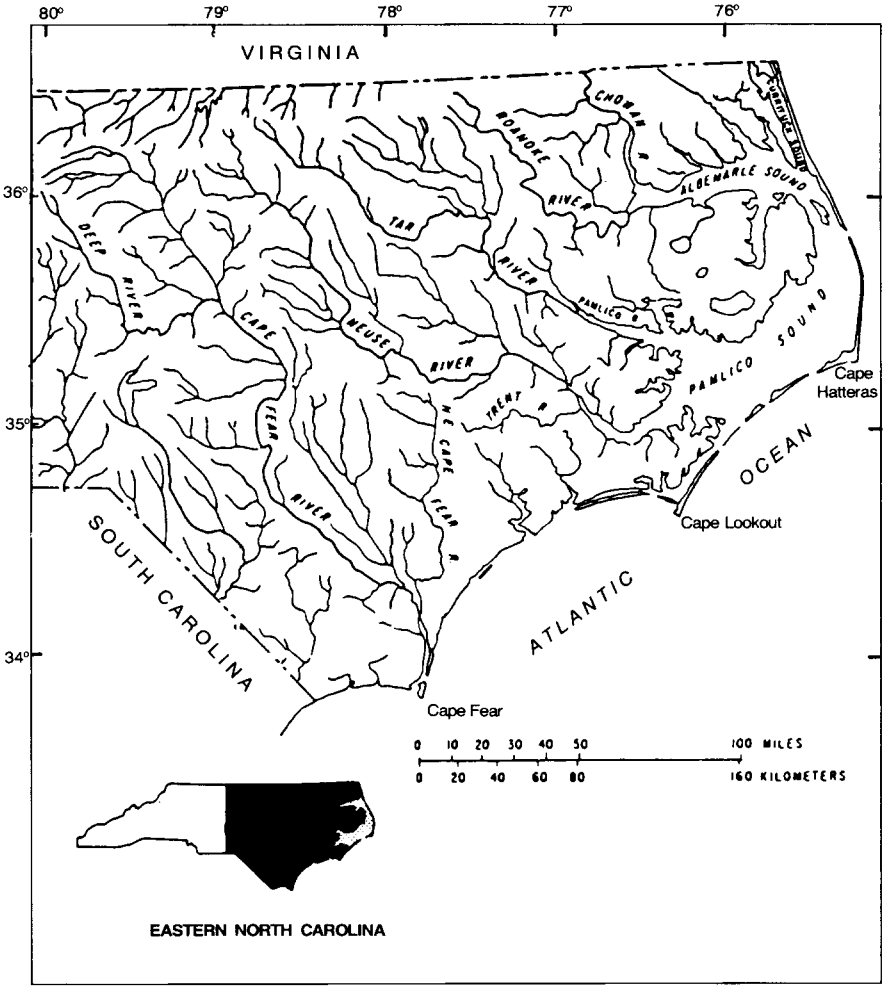

Figure 1. Drainage network of eastern North Carolina and approximate extent of estuaries and sounds. Taken from *Hydrology of Major Estuaries and Sounds of North Carolina,* by G. L. Giese, H. B. Wilder, and G. G. Parker, Jr., U. S. Geological Survey, Water Resource Investigation. 79-46.

The causes of degradation most often associated with agricultural runoff are the following:

- ❑ Sediments
- ❑ Nutrients
- ❑ Pesticides
- ❑ Oxygen-demanding materials
- ❑ Freshwater discharge
- ❑ Bacteria

Sediments

Sediments result primarily from soil erosion. Sedimentation causes turbidity, which can smother marine life, shade out desirable aquatic vegetation, cause shoaling, and carry nutrients and pesticides. Shoaling makes navigation hazardous, reduces the volume of the estuary, and alters marine habitats.

Soil erosion from agricultural lands causes problems in the Albemarle-Pamlico system. According to the Soil Conservation Service's 1982 study, the upper Tar and the upper Neuse River basins are the two most severely eroded basins in North Carolina. The study concluded that the upper Tar River basin alone produced 783,153 tons of sediment annually, 75 percent of which was from cropland.

One reason for these erosion problems is the preponderance of high-value clean-cultivated crops such as tobacco, peanuts, and cotton. Erosion control methods are well known, but implementation has been hindered by land-use patterns. In 1982, 75 percent of the cropland in the upper Tar River basin was leased in relatively short-term agreements, which tend to discourage long-term investments in erosion control.

Growers concerned about erosion should have a farm conservation plan developed in cooperation with their local Soil and Water Conservation District. They can also consult with SCS and Agricultural Extension Service personnel concerning the best management practices (BMPs) for erosion control.

Nutrients

Nitrogen (N) and phosphorus (P) are the nutrients that exert the greatest influence on water quality. Studies have shown that North Carolina estuaries nearly always have excessive amounts of both nutrients: estimates indicate that nitrogen and phosphorus now enter the system at rates 10 to 100 times greater than under forested, nondeveloped conditions; estimates also indicate that phosphorus levels in the Neuse River would have to be reduced by 50 percent to inhibit algae growth. Phosphorus is the most troublesome nutrient, since some nitrogen-fixing nuisance phytoplankton are not dependent on water-borne nitrogen.

The main hazard from excess nitrogen and phosphorus is excessive eutrophication (nuisance algae blooms), which renders the water less desirable for recreation and other uses. Also, as algae die, they deplete the water's oxygen, suffocating marine organisms and further degrading the water.

In the Tar-Pamlico basin, 41 percent of the phosphorus is from Texasgulf Corporation discharges and 39 percent is from nonpoint sources. Efforts are under way to reduce the Texasgulf discharges by an estimated 40 percent. In contrast to phosphorus, 82 percent of the nitrogen in the system comes from nonpoint sources, including agriculture.

The main agricultural source of these nutrients is runoff that carries fertilizers and agricultural manure. Much of the nitrogen from cropland is in the nitrate form that dissolves in surface and subsurface drainage water. Fertilizer or soil phosphorus is mostly associated with sediments since phosphorus commonly bonds with the aluminum in clays.

The most troublesome manures come from swine and poultry, both of which are being produced in increasingly greater numbers. In 1960 there were 1.6 million chickens in the Neuse basin; in 1985 there were over 8 million, a 500 percent increase. In the same period, swine numbers increased by over 50 percent in the counties immediately adjacent to the estuaries.

There are about 3,200 swine producers in the 37 North Carolina counties whose streams drain into the Albemarle-Pamlico estuary. That total represents 51 percent of all North Carolina swine producers. Estimates suggest that only 19 percent of these producers have properly designed lagoons and that only 12 percent are applying the waste to the land. Waste management technology is available, but it needs to be implemented more comprehensively and more efficiently.

Producers can reduce nutrient problems by (1) confining their animals in a way that will contain waste and (2) disposing of that waste through aerobic lagoons and land application at rates determined by soil tests and crop needs. Once manure is applied to the land, the nutrients are treated no differently than if they were supplied by other sources. Pastured animals should be fenced from streams or drainage ways, and filter strips should be used to trap transported nutrients.

A number of nutrient control BMPs have been suggested; they include soil tests to establish fertilization rates, erosion control, careful fertilizer placement, nitrogen timing by crop need, nitrate restrictions on leachable soils, and nutrient recycling through winter-cover trap crops. Trap crops take from the soil nutrients that might otherwise contaminate surface water or groundwater; the trapped nutrients are removed in harvested products or recycled in the crop residue for the subsequent crop.

In the tidewater area, water control structures such as flashboard risers help improve water quality. Properly managed, these structures can reduce nitrate runoff by 50 percent or more. Currently, they reduce nitrogen runoff into the estuary by an estimated 1 million pounds per year. That reduction results mainly from increased denitrification in

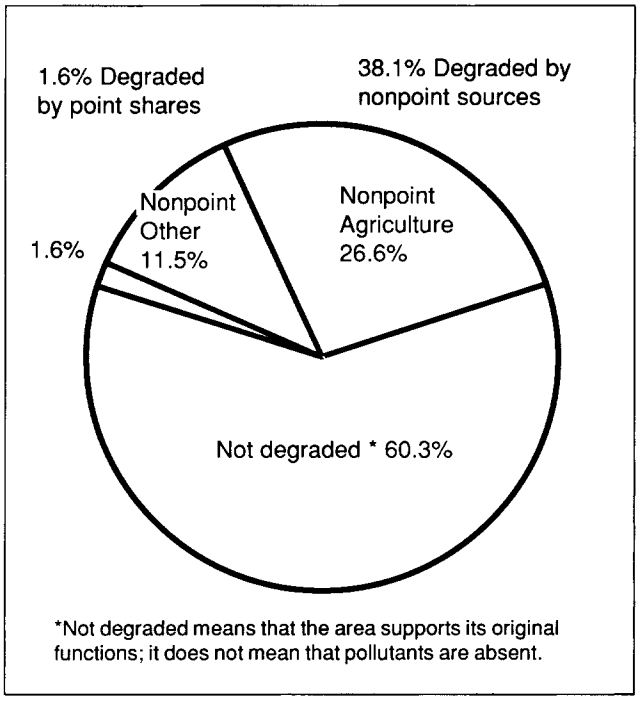

Figure 2. Water quality status of the streams draining into the Albemarle-Pamlico estuary as estimated by the North Carolina Division of Environmental Management.

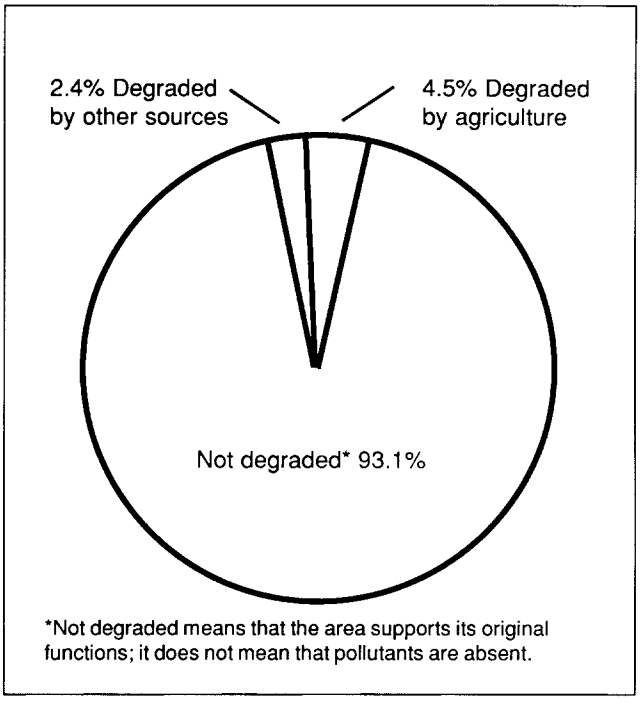

Figure 3. Water quality status of the Albemarle-Pamlico estuary as estimated by the North Carolina Division of Environmental Management.

water-saturated soils. Water control structures can also trap sediments that may be transporting phosphorus or pesticides.

Pesticides

According to a National Oceanic and Atmospheric Administration study, the Albemarle Sound's drainage area exhibits a higher rate of pesticide use per unit of cropland than any other estuarine system in the United States. Pamlico Sound ranks fifth. Although pesticides have been detected in the Albemarle-Pamlico estuary, there is little evidence that they are causing damage. Some pesticides, however, can be directly toxic to marine organisms if used improperly.

Much of the public has a negative attitude about pesticides and wants them kept out of public waters, regardless of toxicity. The primary methods of minimizing pesticide impact include scouting and integrated pest management, choosing the least-toxic alternative pesticide, controlling water and erosion, and properly handling and disposing of pesticides and their containers. The use of bulk returnable containers can sometimes eliminate the problem of container disposal. Also, some pesticides are available as water-soluble packets or wafers, which reduce the chance of user contact and eliminate container residue problems. All producers should use closed handling systems, rinse disposable containers three times, recycle rinse water, and apply pesticides only according to label instructions.

Oxygen-Demanding Materials

Organic materials deplete the water's oxygen supply as they decompose. The main sources of such materials are water-borne microflora and coastal swamps. In agriculture, the main sources are manures and sediments. The amount contributed by agriculture is relatively minor and is controllable by proper manure management and erosion control.

Freshwater Discharge

Both the Pamlico and eastern Albemarle estuarine waters exhibit internal variations in their salinity regimes. The western Albemarle functions as a freshwater system except during extreme drought. Due to the drainage of fresh water from higher land, salinity generally decreases as you move upstream. Many juvenile fish and other marine organisms (such as shrimp) prefer and seek out areas that provide protective cover and intermediate salinity. These nursery areas determine to a large degree the productivity of the estuary. Nonmobile organisms such as oysters also have specific salinity requirements. Should an excessive amount of fresh water enter such a system, salinity alterations can displace or kill marine life. In this case, fresh water acts as a pollutant: it degrades the water it enters.

Agricultural drainage systems can increase inflows of fresh water. Although the total rainfall varies widely from year to year in the tidewater region, annual levels average about 16 inches more than evapotranspiration. To cope with this disparity, producers usually install over 20 miles of ditches and canals on each square mile of agricultural land. While these efforts may not change the total water flow appreciably, they make peak flows greater and shorter. The full effect of this drainage on nurseries is still being debated, but fishery interests are by and large opposed to improved drainage into such areas.

To help avoid these problems, discharge outlets can be relocated or drainage patterns modified. Outlets can be moved outside saline nurseries, and pump discharge sites can be relocated. Drainage patterns can be modified by using water control structures to retain a portion of agricultural runoff and reduce peak flow. Keep in mind, however, that this technique breaks down once the water storage within the ditches is at full capacity.

Another strategy that improves water quality is to drain discharge into a wetland buffer zone. In this case, drainage waters move by sheet flow through wetlands before reaching the estuaries. Research suggests that the ratio of drained agricultural land to buffer should be less than 15 to 1. A diffuser canal should be used to help distribute runoff or pump discharge. Computer modeling indicates that over a 20-year period such a system would remove 82 percent of the nitrate nitrogen, 81 percent of the phosphorus, and 92 percent of the sediments; it would also greatly reduce peak flows from agricultural land. In the future, surplus water may be pumped to storage reservoirs for irrigation or other uses or for release at noncritical times.

Bacteria

A number of pathogenic bacteria can be found in untreated wastewater, including those that cause typhoid fever, hepatitis, and dysentery. Shellfish that ingest pathogenic bacteria can cause disease when eaten by humans. However, the bacteria most often mentioned in connection with water-quality problems are the coliforms, since they are reliable indicators of fecal contamination.

Coliform bacteria are found in the intestinal tracts of man and other animals. Although not pathogenic themselves, these bacteria are easily detectable and usually indicate that animal or human waste is present and, by inference, that pathogens may be present. As a result, shellfish areas are closed to harvest if coliforms are detected, thus causing economic loss to fisherman. At present about 320,000 acres of the estuary are closed to shellfishing. Oysters from such areas can be transferred to clean water and later harvested when the bacteria levels have dropped.

Coliform contamination can come from any source of fecal material. A certain amount is almost always found in nature, but problems arise when untreated animal or human waste enters public water. Malfunctioning septic systems are an obvious source of contamination, as are waste discharges from farm animals. Other sources include urban runoff, which can carry wastes from household pets. On farms, bacterial contamination can be controlled by proper treatment and disposal of animal manure.

Summary

As our population has grown and become more mobile and affluent, competition for resources such as our coastal waters has increased. Many people believe that unless we reduce all potential sources of pollution our waters will become less and less able to support their original functions. Farmers need to be aware of the potential pollutants associated with agriculture and to develop production plans that do not degrade our water.

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