

coastal resources collaborative, ltd.

NC. Coastal Zone Management Program

THE ENVIRONMENTAL IMPACTS OF AGRICULTURE AND FORESTRY:
AN AMENDMENT TO THE LAND USE PLAN OF PAMLICO COUNTY,
NORTH CAROLINA

HT
256
.E68
1984

THE ENVIRONMENTAL IMPACTS OF AGRICULTURE AND FORESTRY:
AN AMENDMENT TO THE LAND USE PLAN OF PAMLICO COUNTY,
NORTH CAROLINA

1984

Coastal Resources Collaborative, Ltd.

The preparation of this document was financed in part through a grant provided by the North Carolina Coastal Management Program, through funds provided by the Coastal Zone Management Act of 1972, as amended, which is administered by the Office of Ocean and Coastal Resources Management, National Oceanic and Atmospheric Administration.

HT 256 .668 1984

Table of Contents

	Page
Introduction	1
Chapter 1 Pamlico County Profile	3
1.1 Natural Setting	3
1.2 Population and Economy	4
1.3 Agriculture	6
1.4 Forestry	7
1.5 Commercial Fisheries	9
Chapter 2 Environmental Impacts of Agriculture and Forestry	11
2.1 Impacts Associated with the Conversion of Natural Areas	11
2.2 Decline in Soil Productivity	13
2.3 Problems Related to Artificial Drainage	15
2.4 Inadequate Restocking of Forested Lands	17
2.5 Freshwater Runoff to Estuaries	18
2.6 Sedimentation	20
2.7 Nutrients	21
2.8 Pathogens	23
2.9 Pesticides	24
Chapter 3 Current Approaches to Reducing Impacts	28
3.1 Technical Solutions and Ipediments to their Adoption	28
3.2 Soil Erosion Programs	30
3.3 Water Quality Programs	34
3.4 Drainage and Water Management Programs	38
3.5 Forest Management Programs	43
Chapter 4 Recommendations	47
4.1 County Policy	47
4.2 Education, Technical Assistance, and Economic Incentives	48
4.3 Support for the Bay River Soil and Water Conservation District	50
4.4 Cross-Compliance	51
4.5 Water Management	53

INTRODUCTION

In Pamlico County, as in many other parts of the coastal plain, agriculture and forestry are two of the area's leading industries and together account for the vast majority of land use. A substantial portion of the county's population derives its livelihood either directly or indirectly from this production of food and timber. Clearly, the long-term economic health and social well-being of the county depend on maintenance of the natural resource base that supports these and other commercial activities.

Unfortunately, not all agricultural and forestry operations in the county are conducted in an environmentally sound manner. Certain practices have been shown to have detrimental effects on the productivity of the land and on the condition and enjoyment of neighboring lands and receiving waters. Such impacts include accelerated erosion, the loss of natural areas and wildlife habitat, freshwater inflow to brackish nursery areas, and noxious inputs of sediment, nutrients, pesticides, and bacteria to receiving waters. Such impacts have the potential for damaging the long-term productivity of agriculture and forestry as well as the quality and productivity of estuarine waters, upon which the county's other leading industry, fishing, depends.

Policy makers in the federal, state, and local governments have recognized many of these problems and have instituted programs to address them. Some programs have been successful in achieving their objectives. Others have not, for reasons of underfunding, poor design, or other causes. In most cases these environmental problems persist, though at levels that are less severe than they would be in the absence of government intervention.

The purpose of this report is to examine the environmental impacts of

agriculture and forestry in Pamlico County, to review the major public programs currently addressing these issues, and to make recommendations to the Board of Commissioners, as appropriate, on measures to further reduce these impacts. The report is divided into four chapters: a profile of the county and its agriculture, forestry, and fisheries industries; a review of the principal environmental impacts of agriculture and forestry in the county; a review of existing federal, state, and county programs designed to reduce or eliminate these problems, and a series of recommendations for the Board, including an amendment to the county land use plan and various options available to implement this policy.

Chapter One

PAMLICO COUNTY PROFILE

1.1 Natural Setting

Pamlico County occupies the outer portion of the peninsula lying between the embayed lower reaches of the Pamlico and Neuse Rivers in the North Carolina coastal plain. The topography of the county was largely shaped during periods of higher sea level. The eastern two-thirds are part of the Pamlico marine terrace, a flat, low-lying surface ranging from 0-20 feet above sea level. This surface is separated from the higher Chowan terrace in the county's western third by the Minnesott Ridge and Grantsboro Scarp, an ancient shoreline feature running north-south through the county along highway 306. The county's modern-day shoreline is dissected by a series of creeks and bays, particularly along the Pamlico Sound shore.¹

Extensive areas of both organic and mineral soils occur. Eighty percent of the county's soils are classified as either poorly drained or very poorly drained. As a result, most of the natural vegetation is hydrophytic (water-loving), and most of the county could be classified as various types of wetlands. Natural habitats in the county once included brackish and fresh marshes, wooded swamps, hardwood flats, pine flatwoods, upland pine stands, and upland mixed pine-hardwood forests.² While substantial portions of the county have been cleared for agriculture or converted to pine plantations, many natural areas remain, ranging in condition from virtually pristine to highly disturbed. Abundant populations of many wildlife species were noted by Barick and Critcher, including deer, small game (quail, rabbit, squirrel,

dove, woodcock, snipe, raccoon, opossum), furbearers (fox, bobcat, mink, otter, muskrat, beaver, nutria), and waterfowl.³

1.2 Population and Economy

Pamlico County's population stood at 10,398 in 1980, an increase of 9.8% over 1970. Population size has remained relatively stable over the years, having fluctuated between 9,000 and 10,000 since the turn of the century.

The most recent county land use data were recorded in 1967 and are shown in Table 1. Cropland expanded steadily in the 1970's and now can be found throughout the county outside the large expanses of marshland along Pamlico Sound and the pocosin bogs of the interior. Urban uses are concentrated for the most part in the county's eight incorporated and several unincorporated towns and in strip development along the major highways.

The economy is natural resource oriented and is dominated by agriculture, fishing, and forestry (Table 2). These three industries accounted for 13% of the county's employment in 1980 (compared with only 3% statewide), and if agricultural services are included, generated an estimated 23% of all personal income in the county in 1978.⁴ The contributions of these industries to the county economy are in fact even larger than these figures would indicate. Much of the manufacturing and wholesale trade in the county is in locally produced food and fiber; in 1977, for instance, 15 of the county's 18 manufacturing establishments involved food processing, and a 16th dealt with wood products.⁵ In addition, many of the retail and service establishments and a large part of government employment are supported indirectly by earnings from agriculture, forestry, and fishing. Clearly, the county is heavily dependent on the continued vitality of these industries.

Table I. Pamlico County Land Use Data

<u>Land Use</u>	<u>Area</u>	<u>% Land Area</u>
Forested	157,000 acres	74 %
Cropland and pasture	33,500	16
Marshland	19,000	9
Urban	<u>2,900</u>	<u>1</u>
Total land area	213,400	100 %
Total water area	<u>151,000</u>	
Total county area	364,400	

Source: N.C. State Univ. Dept. of Economics, "North Carolina Land Use Data," 1967, as cited in Pamlico County 1980 Land Use Plan.

Table 2. Receipts for Agricultural, Forestry and Fisheries Products, Pamlico County

(in thousands of dollars)

<u>Year</u>	<u>Agriculture¹</u>	<u>Forestry²</u>	<u>Fisheries³</u>
1983	N/A	3,621	7,135
1982	15,064	3,395	7,688
1981	12,985	3,183	6,710
1980	13,291	3,012	9,737
1979	11,598	3,260	6,573

1. Cash receipts from farm marketings and government payments minus receipts from farm forest, greenhouse, and nursery, from N.C. Farm Income, published annually by the N.C. Crop and Livestock Reporting Service, N.C. Dept. of Agriculture, Raleigh.
2. County extension agent estimates of receipts for timber sales; figures listed are stumpage prices and therefore represent income minus cost of harvest, unlike the other two columns.
3. Preliminary seafood landings, dockside value, from the N.C. Division of Marine Fisheries.

1.3 Agriculture

Agriculture is Pamlico County's leading industry and second largest land user. It employed 264 county residents in 1980, and farm receipts totalled over \$15 million in 1982.

Trends in farm numbers, size, and acreage harvested over the last thirty years, as recorded by the federal Census of Agriculture, are shown in Table 3. The national trend toward fewer, larger farms, due largely to steady advances in mechanization and worker productivity, is very evident locally. Harvested acreage declined from 1950 to 1969, but increased steadily during the boom years of the 1970's to reach a thirty-year high in 1982. Throughout this period, however, there has been a steady increase in the proportion of farms in harvested cropland, from 41% in 1950 to 70% in 1982, reflecting in part the effect of escalating farm costs.

Principal crops grown in the county, in terms of harvested acreage and income, are soybeans, corn, tobacco, potatoes, and wheat (Table 4). The county has one of the lowest livestock populations of any county in the state;

Table 3. Trends in Pamlico County Agriculture, 1950-1982.

	<u>Number of farms</u>	<u>Average size of farms</u>	<u>Land in farms</u>	<u>Harvested cropland</u>
1982	136	324 acres	44,045 acres	30,718 acres
1978	174	245	42,597	28,129
1974	225	205	46,130	24,132
1969	286	159	45,466	20,533
1964	330	172	56,789	22,458
1959	466	133	61,781	23,699
1954	738	93	68,547	26,393
1950	789	89	66,022	27,080

Source: U.S. Censuses of Agriculture, 1950-1982.

Table 4. Crops Harvested in Pamlico County, 1982.

<u>Crop</u>	<u>Acreage</u>	<u>Value</u> (thousands of dollars)
Tobacco	720	2,632
Corn for grain	9,400	2,652
Soybeans for beans	24,000	3,888
Sweet potatoes	30	24
Irish potatoes	2,550	2,106
Wheat for grain	7,400	876
Oats for grain	180	14
Sorghum grain	1,170	80

Source: North Carolina Crop and Livestock Reporting Service, North Carolina Agricultural Statistics (Raleigh: N.C. Dept. of Agriculture and U.S. Dept. of Agriculture, 1983).

the 1982 Census of Agriculture recorded only 550 cattle, 1800 hogs, and 85 chickens.

One of the distinguishing features of agriculture in Pamlico County is its dependence on artificial drainage. As mentioned earlier, most county soils have high water tables. In 1967 the Soil Conservation Service classified 92% of the county's cropland and 95% of all county land in land capability subclasses marked "w," indicating wetness limitations for agricultural production.⁷ Drainage is necessary to farm most of these soils, and an extensive surface drainage network of canals and ditches exists throughout the county.

1.4 Forestry

Forestry is the largest land user in Pamlico County but ranks behind agriculture and fisheries in income generated. Loblolly pine is the principal species harvested and virtually the only one planted; the rest of the harvest consists of long leaf and pond pines and oak, sweetgum, tupelo, blackgum, and other hardwoods. In 1983 the timber harvest, as estimated by the county

extension agent, amounted to 296,500 cords of pulpwood and 5.48 million board feet of sawtimber.

Estimates of commercial forest land ownership in Pamlico County were made by the U.S. Forest Service in 1974 and are shown in Table 5. Major industrial owners include Weyerhaeuser, Texasgulf, Georgia-Pacific, and Taylor. On these lands, typical management is for a 25-35 year pine rotation that includes one or more thinnings, application of phosphate fertilizer, an optional pruning, and periodic controlled burns of the forest floor.⁸ On small, private holdings, management intensity varies widely with landowner objectives, interest, and availability of funds, and ranges from management as intense as that of the forest industry to no management at all.

The harvests on both industrial and small private holdings are typically done by contract loggers, and most of the harvest is taken to pulp or saw mills in New Bern and Plymouth. Regeneration is accomplished by planting (particularly on industrial holdings) or by natural seeding from seed trees or neighboring tracts.

Table 5. Commercial Forest Land Ownership in Pamlico County, 1974.

	<u>Area</u>	<u>Percentage</u>
Forest industry	35,956 acres	24 %
Farm	32,556	22
Miscellaneous corporate	19,664	13
Miscellaneous individual	57,939	39
State	<u>1,000</u>	<u>1</u>
Total	147,115	99

Source: Richard L. Welch and Herbert A. Knight, Forest Statistics for the Northern Coastal Plain of North Carolina, 1974, USDA Forest Service Resource Bulletin SE-30 (Asheville, N.C.: Southeastern Forest Experiment Station, 1974), p. 14.

1.5 Commercial Fisheries

Commercial fishing was Pamlico County's second leading industry in 1983, generating over \$7 million in dockside earnings and substantially more in the processing, wholesale, and retail trade of fish products. County landings, in weight and value, for the last six years are shown in Table 6. Throughout this period, the county has consistently ranked third in value landed among coastal counties, after Dare and Carteret. Principal species landed are shrimp, flounder, blue crab, grey sea trout, croaker, and spot.

Major fishing ports in the county are Lowland, Hobucken, Vandemere, Bayboro, Pamlico, and Oriental. A total of 848 commercial vessel licenses were purchased in 1983, consisting of 272 full-time licenses, 188 part-time, and 388 pleasure. (The figure of 272 full-time licenses is misleading, as it is doubtful that all of these vessels were used by bona fide full-time fishermen. Only 108 of these vessels were over 25 feet in length and 111 were under 21 feet, and many of the latter were probably not used full-time.) The county had 58 licensed seafood dealers in 1983, with the greatest concentrations in Lowland, Bayboro, and Oriental.⁹

Table 6. Seafood Landings, Pamlico County, 1978-1983.

<u>Year</u>	<u>Landings</u> (thousands of pounds)	<u>Dockside Value</u> (thousands of dollars)
1983	14,022	7,135
1982	14,020	7,688
1981	17,329	6,710
1980	21,381	9,737
1979	19,524	6,573
1978	15,412	4,317

Source: Preliminary seafood landings, N.C. Division of Marine Fisheries, Morehead City, N.C.

FOOTNOTES

1. S. Lance Peacock and J. Merrill Lynch, Natural Areas Inventory of Pamlico County, North Carolina, CEIP Report No. 29 (Raleigh: N.C. Dept. of Natural Resources and Community Development, 1982), pp. 1-3.
2. Ibid., p. 5.
3. Frank B. Barick and T. Stuart Critcher, Wildlife and Land Use Planning With Particular Reference to Coastal Counties (Raleigh: N.C. Wildlife Resources Commission, 1975).
4. Bureau of the Census, 1980 Census of Population, Vol. 1, Characteristics of the Population, Chapter C, General Social and Economic Characteristics, Part 35, North Carolina (Washington, D.C.: U.S. Dept. of Commerce, 1983), pp. 64, 443; U.S. Dept. of Commerce, Bureau of Economic Analysis, Regional Economic Analysis Division, data supplied by N.C. Office of State Budget and Management, Raleigh.
5. Bureau of the Census, 1977 Census of Manufacturers, Vol. III, Geographic Area Statistics, Ch. 34, North Carolina (Washington, D.C.: U.S. Dept. of Commerce, 1980), p. 34-38.
6. Bureau of the Census, 1982 Census of Agriculture Preliminary Report, Pamlico County, N.C. (Washington, D.C.: U.S. Dept. of Commerce, 1984).
7. Soil Conservation Service, North Carolina Conservation Needs Inventory (Raleigh: U.S. Dept. of Agriculture, 1971).
8. Andrew N. Ash, Charles B. McDonald, Emilie S. Kane, and Carolyn A. Pories, Natural and Modified Pocosins: Literature Synthesis and Management Options, FWS/OBS-83/04 (Washington, D.C.: U.S. Fish and Wildlife Service, 1983), p. 45.
9. N.C. Division of Marine Fisheries, Morehead City, N.C.

Chapter Two

ENVIRONMENTAL IMPACTS OF AGRICULTURE AND FORESTRY

The environmental impacts of agriculture and forestry in Pamlico County can be divided into those whose principal impact is at the site of the activity, and those whose principal impact is off-site. By legal tradition, the focus of environmental protection efforts has always been on off-site impacts where injury to others could be clearly shown. In recent years, however, there has been growing interest in on-site impacts as well, and a tempering of private property rights with the notion that society has a legitimate interest in maintaining a productive land base for future generations and that private landowners have an obligation to practice good land stewardship. In particular, these latter views have received increasing support as the implications of the country's alarming rates of soil erosion have received greater attention. It is argued that Pamlico County not only can but must be concerned with on-site environmental impacts, particularly those that threaten long-term land productivity, if the economic future of the county is to be assured.

On-Site Impacts

2.1 Impacts Associated With the Conversion of Natural Areas

The conversion of natural areas to agricultural use and forest plantations was widespread in Pamlico County and the rest of the coastal plain during the 1970's, but in the last several years has dropped off dramatically. Such conversions may have several adverse impacts on the areas involved:

(1) Loss of natural ecosystems. In its natural state, the county contained a diverse array of natural ecosystems, including various wetland types and upland forest communities. With development, some of this diversity has been lost. The area of many habitat types has been reduced, and much of the rest has been subject to some disturbance, though a number of high quality natural areas remain.¹ Further conversion of natural areas to agriculture and intensive forestry will result in further losses of this natural diversity and of the county's natural heritage.

Agriculture and forestry are not the sole causes of this decline. Residential and other types of urban development are responsible for some losses, and future large-scale mining of peat and phosphate deposits may significantly reduce the natural acreage that remains.

(2) Loss of wildlife habitat. While the conversion of natural areas will mean some loss of wildlife habitat and productivity, the extent of this loss will depend on the extent to which wildlife concerns are incorporated into agricultural and forestry management. Barick and Critcher identify several agriculture and forestry management practices in the coastal plain that are particularly detrimental to wildlife, including the creation of large, even-aged pine plantations, the widespread use of pesticides, the channelization of streams and destruction of bottomland hardwoods, the consolidation of small fields and elimination of shrubby fence rows, and uncontrolled erosion and concomitant stream sedimentation.² Many of these practices can be minimized or eliminated with little impact on farm and forest income, but with large positive benefits for wildlife productivity. Monschein notes that there are a number of measures that farmers and foresters can take to maintain wildlife populations and, in certain situations, even to increase wildlife productivity over that of the natural system.³

(3) Decline in aesthetic quality. Personal tastes vary, of course, but for many the conversion of natural areas to managed forests and farmland entails some loss of aesthetic quality. This will be particularly true in recently logged areas and where wildlife populations are substantially reduced.

2.2 Decline in Soil Productivity

Certain agricultural and forestry practices may cause soil productivity to decline, for several reasons.

(1) Erosion. Accelerated erosion is a likely consequence whenever soil is left exposed to the erosive power of water and wind. Major causes of farmland erosion are deep plowing, the cultivation of row crops (whose acreage has expanded statewide by almost 50% in the last 15 years, and which occupy the vast majority of harvested cropland in Pamlico County), and exposed ditch and canal banks. On forest land, most erosion occurs during and immediately after harvest and site preparation and is concentrated at forest roads and skid trails.

As topsoil is lost to erosion, the water storage capacity of the soil decreases, more energy is required for tillage, greater applications of lime and fertilizers are needed, and yields decline. Erosion is a long-term problem; its effects appear only gradually, and restoration of eroded soils may take decades and even centuries.

As in most counties of the outer coastal plain, accelerated erosion from agricultural and forestry activities on the level soils of Pamlico County is not a widespread problem and does not approach the magnitude it does in the Piedmont. The county's district conservationist estimates that most of the farmland in the county erodes at a rate of less than 5 tons of soil per acre

per year, the maximum rate at which erosion can occur without a long-term decline in productivity. (This figure, known at the tolerance level or T-value, represents the rate at which new soil can be built from subsoil.) Most of the county's remaining farmland is thought to erode at approximately this rate. By comparison, the average rate for all North Carolina farmland in 1977 was 7.6 tons/acre/year.⁴

However, there are some lands, particularly in the western part of the county where relief is greater, that do have erosion problems. In 1967 the Soil Conservation Service identified 2484 acres, or 8% of the cropland in the county, as "e" cropland, indicating that it possessed an erosion hazard. The actual erosion rate of this cropland is not known, but the acreage in each of the three "e" land capability subclasses in the county, together with average statewide erosion rates for land in these subclasses in 1977, are:

<u>Subclass</u>	<u>Acreage of Cropland in Pamlico County⁵</u>	<u>Average Sheet and Rill Erosion Rate for N.C. Cropland⁶</u>
2e	1863 acres	11.8 tons/acre/year
3e	414 "	16.2 "
4e	207 "	17.7 "

While these figures do not indicate how fast these Pamlico County soils are eroding, they do indicate the erosion potential of these lands. Other land capability classes of cropland in the county (2w, 3w, 4w, 7w), constituting the remaining 92%, had average statewide erosion rates in 1977 of 3 tons/acre/year or less.⁷

Forest land, by comparison, had an average statewide sheet and rill erosion rate (comparable to the above figures) of only 0.14 tons/acre/year.⁸ Erosion rates in coastal plain forests are even lower.

The general conclusion to be drawn from this information is that, while most forest and agricultural lands in the county do not have erosion problems

that threaten long-term soil productivity, some county soils do have an erosion potential that warrants concern and attention. Furthermore, it should be kept in mind that erosion at rates well under the tolerance level may still cause sedimentation problems in receiving waters (see the discussion of sedimentation later in this chapter).

(2) Other impacts on soil productivity. Careless forestry practices may result in a more immediate decline in soil productivity. Part of the reason why such practices are more common in forestry operations is that, unlike agriculture, forest operators are paid on a cash basis and have no stake or interest in the yield of the next "crop," providing them with less incentive to protect the soil. These practices include: (A) Soil disturbance when wet, particularly by heavy logging equipment. Such disturbance compacts the soil and destroys its structure, reducing tree growth rates. Without assistance, such soils may take a century to regain their original productivity. (B) Careless destruction of natural drainage during logging, particularly by road construction across small or intermittent stream channels. The result is poorer drainage and reduced yields. (C) Improper site preparation. There have been instances of K-G operations that scraped off too much soil and piled it in windrows, resulting in alternating rows of rich and poor soil.

2.3 Problems Related to Artificial Drainage

(1) Land subsidence. Subsidence occurs on deep organic soils when the land is drained and converted to other uses. It is caused by oxidation of organic material, either by biochemical action and/or by fire, and by the irreversible drying and shrinkage of the soil. If subsidence continues over time, additional investments in drainage become necessary, the area's

hydrology is further altered, and the susceptibility of the area to flooding is increased.

Research results on subsidence rates present a complex and sometimes contradictory picture. Heath cites studies by Dolman and Buol on land west of Lake Phelps that indicated subsidence in organic soils of 2 feet due to drainage alone, and of 3 to 6 feet due to compaction, fires, and slow oxidation.⁹ The N.C. Soil and Water Conservation Commission, on the other hand, cites other research showing that subsidence elsewhere did not occur beyond the curing of a thin (8-10") surface layer.¹⁰ Skaggs and co-workers found that subsidence of organic soils on the Hyde County pasture they studied was greatest directly after development, but quickly declined to less than 1 mm per year.¹¹ On the other hand, studies in the Florida Everglades found rates of subsidence varying from 0.6 to 2.3 inches per year, depending on the depth to the water table.¹²

(2) Salt water encroachment. Artificial drainage for agriculture and forestry may result in the encroachment of salt water into previously fresh water areas via several means. By lowering the height of the water table, drainage reduces the hydraulic head maintaining the deep, fresh water aquifers and allows salt water to rise into previously fresh zones. (In fact, salt water was probably rising as a result of sea level rise before man even entered the area, but drainage will tend to increase the rate of advance.)¹³ Drainage canals also provide conduits for salt water encroachment from the sounds into the shallow, ground water table aquifer during high wind tides when flow in the canals is reversed, and at other times where the bottom of the drainage canal is below sea level. Drainage-induced subsidence also increases the area and depth of storm floods. The result is salt contamination both of the soil, which will reduce yields during the 2 to 3

years needed to flush the salt out, and of the shallow aquifer. While salt contamination of the root zone is a familiar problem to county farmers, relatively little is known about the impacts of drainage on salt water encroachment in Pamlico County aquifers.

2.4 Inadequate Restocking of Forested Lands

A substantial portion of the woodland in Pamlico County is not adequately restocked following harvest. The county forester has estimated that only about one third of the harvested acreage is replanted. On some of the remaining acreage natural seeding produces adequately stocked timber stands, but on other parcels where the seed supply is insufficient or conditions do not favor seed germination and seedling survival, regrowth is to hardwood brush of little or no economic value. The result is that thirty or forty years later there will be no trees available for harvest on those parcels to meet growing timber demand, and the economic base of the county will have been depleted.

There are several causes for landowners' failure to restock, but the most important is that people are reluctant to make sizable investments (\$50 to \$250 per acre for replanting) in practices that won't provide a return for thirty or forty years. Partly as a result, in 1974 the U.S. Forest Service found approximately 25% of the commercial forest land in the county, or 37,000 acres, poorly stocked.¹⁴ In 197 the N.C. Forest Service estimated that an equal percentage, 25% or 27,540 acres, of the county's private nonindustrial forest land was in need of forest regeneration.¹⁵

Off-Site Impacts

Neighboring lands will be subjected to some smoke and dust from land clearing activities, prescribed burning on forest lands, and wind erosion and field operations on agricultural lands. Most off-site impacts, however, will be caused by freshwater runoff from these lands and the pollutants it carries: sediment, nutrients, pesticides, and pathogens. Unfortunately relatively little is known about the concentrations and impacts of these pollutants in the receiving waters of Pamlico County, and one must rely heavily on research elsewhere in the coastal plain to help construct a realistic, if probabilistic, picture of current conditions.

2.5 Freshwater Runoff to Estuaries

The estuarine waters bordering Pamlico County are highly productive and support a large fishing industry. Of particular importance in maintaining this resource are the so-called primary nursery areas, where the initial post-larval development of many commercially important finfish and shellfish takes place. Located in the upper reaches of tidal creeks and bays, these areas typically are surrounded by regularly or irregularly flooded marshes and have soft mud sediments and salinities in the 5 to 15 parts per thousand range. State statutes and regulations protect these areas from certain commercial fishing activities and from dredging and filling operations that might impair their productivity.¹⁶

Pamlico County contains one of the largest concentrations of primary nursery areas of any coastal county. Sixty-one different areas are designated by state fisheries regulations,¹⁷ scattered along the east and northeast shore of the county from Oriental to Goose Creek.

Unfortunately, many drainage canals empty into these nursery areas or into creeks leading into them. This drainage network is designed to remove water rapidly from inland areas, and does so by providing efficient short-cuts past the bogs, swamps, marshes, and other areas that once temporarily retained water and regulated surface runoff. The result is peak runoff rates in drained areas that occur sooner and are higher (3 to 4 times in one study¹⁸) than in undrained areas. These pulses of freshwater discharge may affect juvenile fish inhabiting nursery areas by creating salinity conditions that stress the fish or the food organisms they rely on, and possibly by disrupting the currents these juveniles use to reach these areas.

In the most significant research yet on this subject in North Carolina, researchers comparing altered and natural nursery areas in and near Rose Bay in Hyde County came to several conclusions:

(1) Nursery areas appear to have the capacity to absorb some "man-made" drainage without large fluctuations in salinity.

(2) Extensive drainage into nursery areas reduces their value as estuarine habitat by reducing average salinities and by making salinity more sensitive to the effects of rainfall in the drainage basin.

(3) Most importantly, the juvenile forms of all five species examined (brown shrimp, spot, croaker, southern flounder, and blue crab) were found in greater abundance in nursery areas with no man-made drainage and with stable salinity patterns.¹⁹

Many questions about the effects of freshwater inflow remain unanswered. The studies at Rose Bay have continued, and a new research program is planned for Broad Creek in Hyde County that will permit the experimental manipulation of freshwater inputs and will provide data under more controlled conditions. But there is little question that artificial drainage networks do have

detrimental effects on nursery areas. The issue has created a great deal of interest and is currently one of the most pressing environmental problems in the coastal region, particularly in counties like Pamlico where concentrations of nursery areas occur and where both agriculture and fisheries are major segments of the local economy.

2.6 Sedimentation

High sediment inputs to streams and estuarine waters can have several adverse effects. Of greatest concern are the physical and chemical changes in bottom sediments and the destruction of benthic organisms, which together may result in long-term changes in the ecology and productivity of the area. Siltation of shellfish (primarily oyster) beds, burial of fish spawning beds, and reduced light transmission and photosynthesis from high turbidities may also occur.

In the coastal plain sedimentation tends to be greatest during land clearing and shaping operations and during the digging and maintenance of drainage ditches. Significant damage to oyster beds has resulted from such operations in the past, and now settling basins and other measures are often used to reduce such impacts.

Once such operations are complete, sediment inputs drop off significantly. Some sedimentation continues, though, primarily as a result of eroding fields and unprotected ditch banks. Studies in other coastal plain counties have found rates of sediment input from agricultural lands 3 to 30 times higher than those from forested watersheds.²⁰ Streams channelized for drainage improvement also have higher turbidities and sediment loads than unchannelized ones, presumably because the faster flow provides more energy for transport and because the filtering effect of adjacent wetlands is eliminated.²¹

Some researchers and policy makers have suggested that because of the low erosion potential of flat coastal plain soils, agricultural operations are unlikely to create sediment water quality problems, particularly in relation to the much greater rates of sedimentation in Piedmont watersheds. Others have pointed out that while erosion and sedimentation may be much lower than in the Piedmont, (1) Piedmont inputs to estuaries are much reduced by distance, (2) many coastal plain canals and streams empty directly into sensitive estuarine habitats, and (3) outer coastal plain sediments tend to be more organic and colloidal than those of the Piedmont, are more easily suspended and transported, and change the physical bottom conditions more drastically when they settle. Pamlico County fishermen, for instance, have complained of the dark, organic muck that seems to clog many creek bottoms. While sedimentation is perhaps not the severe problem it is in other watersheds in the state, it does occur and should be of concern to those interested in maintaining the productivity of the county's streams and estuarine waters.

2.7 Nutrients

Nitrogen and phosphorus are the principal elements implicated in the eutrophication of water bodies. Nonpoint inputs from agricultural runoff, derived largely from fertilizers and animal wastes, are among the major sources of these elements. In the Chowan River, for instance, 79% of the nitrogen input and 23% of the phosphorus are estimated to originate from agricultural sources.

Nutrient yields from specific watersheds depend on many factors, including land use, agricultural practices, topography, soil type, drainage,

stream channel conditions, and rainfall. Examples of how these factors may influence nutrient yields in coastal plain watersheds include:²²

(1) Nitrogen and phosphorus losses from agricultural watersheds are consistently higher than those from forested ones; in the coastal plain they average roughly 4-5 times higher.

(2) Phosphate tends to bind tightly to sediment, while nitrate is much more readily leached from the soil and transported in solution. As a result, erosion control is also effective in reducing phosphorus inputs, but far less so with nitrogen. In organic soils, however, phosphorus has nothing to bind to and is readily lost in solution.

(3) Under anaerobic, or deoxygenated, conditions, which readily occur in flooded soils, nitrate is broken down by denitrifying bacteria and the nitrogen is released to the atmosphere. As a result, poorly drained soils generally lose less nitrogen in runoff waters than do well-drained soils.

(4) Kuenzler and others found higher nitrogen and phosphorus loads in their channelized streams than in unchannelized ones. This is partly due to the fact that the channelized streams they studied received more agricultural runoff and livestock and sewage wastes than unchannelized ones, but also to absence in the former of functioning swamp floodplain systems to strip the nitrogen and phosphorus from the water.

(5) Most of the nitrogen and phosphorus lost annually is lost in a few large storms.

In Pamlico County nuisance blooms have occurred in drainage canals and in the creeks at Oriental, but none yet in the brackish waters along the coast, including nursery areas. In part, this is due to the fact that most nuisance species, particularly the blue-green algae, are freshwater species and cannot tolerate brackish conditions. In addition, blooms generally require long

periods of relatively stagnant water to develop. The coastal waters of Pamlico County have a high energy level, with wind generated mixing and flushing by wind tides, producing physical conditions less suitable for bloom development.

This is not to say that nuisance blooms in coastal waters, and particularly the sheltered creeks and bays that serve as nursery areas, could not occur. The bloom would be made up of different species of algae, but in disrupting the phytoplankton population it could still have major effects on zooplankton and other groups further up the food chain, including commercially important finfish and shellfish. The situation warrants continuing attention. Reductions in nitrogen and phosphorus inputs, while apparently not immediately necessary, would nonetheless be welcome, particularly to prevent greater problems from developing.

2.8 Pathogens

A variety of pathogenic bacteria in human sewage and animal wastes, if released to shellfish waters, may be taken up by shellfish and passed on to humans when the shellfish is eaten. The pathogens most frequently transmitted through water are those that cause typhoid and paratyphoid fevers, dysentery, and cholera. Fecal coliform bacteria, while not themselves dangerous, are used as an indicator of the presence of these organisms, and the FDA has promulgated fecal coliform standards for closing shellfish waters that are applied and enforced by the state's Shellfish Sanitation section in the Division of Health Services. While the correlation between fecal coliform levels and health risks continue to be debated, high coliform levels do result in the closing of shellfish waters and a potential loss of fishing income. Thus high fecal coliform levels are of concern to the county on two counts: as

indicative of potential health risks, and as the immediate cause of shellfish water closings.

The principal sources of fecal coliform in Pamlico County are improperly functioning septic tanks and livestock wastes. No assessment is available of the relative contribution of each. But the effect is clear: in June of 1984, 16,075 acres, or 12% of the 134,450 acres in the county classified as potential shellfish waters, were closed to commercial harvest. Elsewhere in the coastal plain, elevated fecal coliform levels have been found in canals draining pastures. This increase from grazed lands is common throughout the U.S. and apparently causes few problems, as a marked reduction in concentration occurs within 5 km. downstream. but where grazed lands or feedlots occur close to shellfish waters, the potential for trouble exists.²³ While the county's low livestock population results in a relatively small amount of waste generated, the county also has a large proportion of its land in close proximity to shellfish waters.

2.9 Pesticides

Pesticides include such a wide variety of chemicals that it is difficult to generalize about the impacts of their use. Their pollution potential will depend on their toxicity, persistence, ease of transport, and other factors. Some persist in the environment for years or even decades, while others break down into nontoxic forms within days of their application. Most bind readily to soil particles so that pesticide losses are correlated to soil erosion, and control of the latter will reduce the former. Others, including many herbicides, are transported mainly in solution. Summarizing a number of studies, the Agricultural Research Service concluded that "except when heavy rainfall occurs shortly after treatment, concentrations are low and

the total amount of pesticide that runs off the land during the crop year is less, often much less, than 5% of the application."²⁴

One of the most easily manipulated factors controlling the pollution potential of pesticides is the care with which they are applied. The direct spraying of or drift into water bodies results in much larger inputs of pesticides into these systems. Skaggs and co-workers found that concentrations of the herbicide alachlor in the drainage water from their study area in Hyde County suggested that some applicators were careful to avoid spraying the V-ditches in the fields and others were not, resulting in excessively high concentrations in drainage water after some applications.²⁵ Even these concentrations, though, were reduced by dilution to nontoxic levels by the time the runoff reached biologically productive receiving waters.

The Division of Environmental Management has no records of fish kills or complaints of overspraying in Pamlico County. As long as toxic chemicals are used, though, the potential for pesticide pollution exists. The magnitude of this potential will continue to depend on how well a series of people, ranging from the state Pesticide Control Board to local dealers and applicators, do their jobs correctly.

FOOTNOTES

1. See S. Lance Peacock and J. Merrill Lynch, Natural Areas Inventory of Pamlico County, North Carolina, CEIP Report No. 29 (Raleigh: N.C. Dept. of Natural Resources and Community Development, 1982).
2. Frank B. Barick and T. Stuart Critcher, Wildlife and Land Use Planning With Particular Reference to Coastal Counties (Raleigh: N.C. Wildlife Resources Commission, 1975).
3. Tom Monschein, "Values of Pocosins to Game and Fish Species in North Carolina," pp. 155-170 in: Curtis J. Richardson, ed., Pocosin Wetlands (Stroudsburg, Pa.: Hutchinson Ross, 1981).
4. U.S. Dept. of Agriculture (USDA) and the N.C. Dept. of Natural Resources and Community Development (NRCD), Phase I National Resources Inventory -- North Carolina, as cited in: Division of Soil and Water Conservation, NRCD, A Long Range Plan for Soil, Water and Related Resource Conservation in North Carolina, 1981-1986 (Raleigh: Div. of Soil and Water Conservation, n.d.).
5. Soil Conservation Service, North Carolina Conservation Needs Inventory (Raleigh: U.S. Dept. of Agriculture, 1971).
6. USDA and NRCD, Phase I National Resources Inventory, cited above.
7. Ibid.
8. Ibid.
9. Ralph C. Heath, Hydrology of the Albemarle-Pamlico Region, North Carolina, U.S. Geological Survey Water Resources Investigations 9-75 (Raleigh: USGS, 1975), p. 86.
10. N.C. Soil and Water Conservation Commission and the 208 Agricultural Task Force, Water Quality and Agriculture, A Management Plan (Raleigh: N.C. Soil and Water Conservation Section, Div. of Land Resources, NRCD, 1979), p. 19.
11. R.W. Skaggs, J.W. Gilliam, T.J. Sheets, and J.S. Barnes, Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region, WRR I Report No. 159 (Raleigh: Water Resources Research Institute, 1980), p. xviii.
12. Heath, Hydrology of the Albemarle-Pamlico Region, cited above, p. 86.
13. Ibid., pp. 45-47, 88-93.

14. Richard L. Welch and Herbert A. Knight, Forest Statistics for the Northern Coastal Plain of North Carolina, 1974, USDA Forest Service Resource Bulletin SE-30 (Asheville, N.C.: Southeastern Forest Experiment Station, 1974), p. 17.
15. Bay River Soil and Water Conservation District, Long Range Plan 1983-1988, p. 31.
16. See the state's Dredge and Fill Act (N.C.G.S. §113-229), Coastal Area Management Act (N.C.G.S. §113A-100 et seq.), and coastal fishing regulations (15 NCAC 3B .1400).
17. 15 NCAC 3B .1405.
18. Skaggs and others, Effect of Agricultural Land Development, cited above, pp. 37-39.
19. Preston P. Pate, Jr. and Robert Jones, Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina, UNC Sea Grant Working Paper 81-10, UNC Sea Grant College Program, Raleigh.
20. Skaggs and others, Effect of Agricultural Land Development, cited above; Frank J. Humenik, Beverly A. Young, and Fred A. Koehler, "Agricultural Nonpoint Source Control: Case Studies in North Carolina, III. Chowan River Priority Watershed," N.C. Division of Environmental Management, Raleigh, 1983.
21. Edward J. Kuenzler, Patrick J. Mulholland, Laura Anne Ruley, Robert P. Sniffen, Water Quality of North Carolina Coastal Plain Streams and Effects of Channelization, WRI Report No. 127 (Raleigh: Water Resources Research Institute, 1977).
22. See Skaggs and others, Effect of Agricultural Land Development, Humenik and others, "Agricultural Nonpoint Source Control," Kuenzler and others, Water Quality of North Carolina Coastal Plain Streams, all cited above; and Andrew N. Ash, Charles B. McDonald, Emilie S. Kane, and Carolyn A. Pories, Natural and Modified Pocosins: Literature Synthesis and Management Options, FWS/OBS-83/04 (Washington, D.C.: U.S. Fish and Wildlife Service, 1983).
23. Skaggs and others, Effect of Agricultural Land Development, cited above.
24. U.S. Dept. of Agriculture, Agricultural Research Service, Control of Water Pollution from Cropland, Vol. II: An Overview, Report ARS-H-5-2 (Washington, D.C.: Agricultural Research Service, USDA, and Office of Research and Development, USEPA, 1976).
25. Skaggs and others, Effect of Agricultural Land Development, cited above.

Chapter Three

CURRENT APPROACHES TO REDUCING IMPACTS

3.1 Technical Solutions and Impediments to Their Adoption

In most cases, solutions to the problems identified in Chapter Two exist that are technically feasible and that can be applied by individual landowners and operators or by management agencies. Erosion and sedimentation from cultivated fields, for instance, can be reduced through the use of conservation tillage, cover crops, grassed waterways, field borders, windbreaks, stripcropping, and a variety of other practices. The U.S. Soil Conservation Service has decades of experience in developing and testing erosion control practices and can provide detailed specifications to farmers on the installation of these measures. As part of the state's water quality management planning process, SCS published in 1978 an extensive compilation of best management practices for controlling sediment inputs from agricultural lands in the state.¹

Experience and research with forestry practices throughout the country have built up an extensive body of knowledge on the control of water pollution from silvicultural activities. This material also has been compiled and published for use in North Carolina.² Recommended practices include the use of filter strips and culverts, the proper location and construction of access roads, skid trails, landings, and decks, and the proper conduct of site preparation, fertilizing, and pesticide spraying operations.

Even for such recently identified problems as the large pulses of freshwater input to nursery areas, a range of potential solutions exists, though more research and testing are needed. These approaches include

detention ponds, diversion of freshwater runoff from nursery areas to open shoreline, use of sheetflow through swamps and marshes, and use of companion areas of cropland, pasture, and forest (the latter two, having less demanding drainage needs than cropland, are used for temporary storage of cropland drainage).

Research continues to refine these management practices and develop others. A great deal of research is still needed on the relative cost-effectiveness of different practices and on the development of systems of best management practices suited to the conditions of specific regions. The point to be made, though, is that technical solutions to most of the problems identified in Chapter Two are readily available. If this is the case, the next question is: why do these problems persist?

There appear to be a variety of reasons. Cost is a major one. The return from investments in soil conservation are often very low, and there may be no return from best management practices for pollution control. Many farmers and forest owners cannot afford the high costs of some management practices, particularly those requiring large initial investments in construction or equipment. A second, related reason is risk: the danger that an installed practice will not produce the expected return, or even worse, result in lower yields.

Tradition and social pressures play major roles in rural communities and sometimes work against the adoption of environmentally sound management practices. Conservation tillage is a good case in point. Many farmers pride themselves on the neat, clean-tilled appearance of their corn and bean fields. Their reluctance to suddenly adopt a practice that entails leaving crop residues on the surface is understandable.

Ignorance of the impacts of poor management practices is also common. The effects of erosion are sometimes difficult to discern, and farmers and forest owners may be completely unaware of their contributions to water quality problems in drainage waters far downstream. Indifference and carelessness also play a role: in a survey of county forest rangers in North Carolina, 42% cited these causes as the principal reasons for less-than-good forestry operations in their counties.³

Tenure arrangements are frequently cited as a reason why best management practices are not adopted. Short-term contracts remove the incentive for farm tenants and renters to invest in erosion control practices. Such problems have been cited in Pamlico County, where 49% of the 44,000 acres in farms in 1982 was rented.⁴

For these and other reasons, many farmers and forest owners have not voluntarily and spontaneously adopted adequate soil and water conservation measures. It has been to address this failure that a variety of government programs and institutions have been established.

Though many of the programs described below have multiple objectives and broad responsibilities, for ease of discussion they have been classified under the heading where their principal objectives with regard to agriculture and forestry, and often their historical roots, lie.

3.2 Soil Erosion Programs

Many of the public programs and institutions dealing with soil erosion date to the 1930's and owe their existence to the impetus the Dust Bowl gave to soil conservation efforts. These include the two principal federal soil conservation programs today, the Conservation Operations Program of the Soil Conservation Service, and the Agricultural Conservation Program of the

Agricultural Stabilization and Conservation Service, both in the U.S. Department of Agriculture (USDA).

The Conservation Operations Program was authorized by the 1935 Soil Conservation Act⁵ that created the Soil Conservation Service (SCS) in USDA to develop and maintain a continuing federal program of soil and water conservation. Under Conservation Operations, SCS, working in cooperation with the nation's 3000 soil and water conservation districts, provides technical assistance to agencies and individual landowners to "reduce soil losses from erosion, help solve soil, water, and agricultural waste management problems, bring about adjustments in land use as needed, and reduce damage caused by excess water and sedimentation."⁶ SCS maintains a state office in Raleigh and area and county offices throughout North Carolina, including one in Pamlico County staffed by a district conservationist. This conservationist provides technical assistance to landowners through the local soil and water conservation district, as specified in a memorandum of understanding; most of this assistance in Pamlico County is directed at soil erosion and drainage problems.

The Agricultural Conservation Program (ACP) was authorized by the Soil Erosion and Domestic Allotment Act of 1936⁷ and is administered by the Agricultural Stabilization and Conservation Service (ASCS) in USDA. The program provides cost-sharing assistance to farmers for carrying out enduring conservation and environmental protection measures, including erosion control practices (stripcropping, grassed waterways, conservation tillage, and others), water conservation, and forest and wildlife management. Practices that are primarily production oriented or have little or no conservation or pollution abatement benefits are no longer eligible for funding; this change,

made several years ago, removed drainage improvements from the list of eligible practices.

In Pamlico County the program is administered by the elected county ASC Committee based on national and state directives and the advice of other resource specialists in the county. The SCS conservationist provides technical assistance on the practices employed, and must certify that the practice was installed to the required specifications before any cost-share payment is made. Landowners must also agree to maintain cost-shared improvements. Currently the cost-share rate for most practices is 60%, with an annual limit of \$3500 per individual. ACP funds expended in Pamlico County in recent years are:

1984 allotment	\$11,258
1983 expenditure	14,100
1982 "	6,374
1981 "	17,562

In February of 1937, President Roosevelt submitted "A Standard Soil Conservation Districts Law" to the states. North Carolina became the second state to adopt a law based on that model by enacting the Soil Conservation Districts Law⁸ later that year. The act contains enabling legislation for the establishment of soil and water conservation districts as distinct units of local government, governed by a board of supervisors, to provide for the conservation of soil, water, and related resources. Districts are given the authority to develop comprehensive plans for soil and water conservation within the district, to conduct water resources conservation and development projects, to cooperate with and furnish aid to agencies and landowners, to buy and sell property, and to adopt land use regulations.

Pamlico County was originally part of the five-county Lower Neuse Conservation District organized in 1944. In 1972 the district split into

single-county districts, and the Bay River Soil and Water Conservation District was organized in Pamlico County. It is governed by a board of five supervisors, three elected in general county elections and two appointed by the state Soil and Water Conservation Commission from nominations made by the elected supervisors. The District's principal activities are the provision of technical assistance to agencies and private landowners on matters of soil and water conservation, primarily through services of the SCS district conservationist provided under a Memorandum of Understanding, and the promotion of soil and water conservation through various educational and informational programs, including publications, meetings, school contests, and other activities. The district's only staff is a part-time secretary. Funding levels in the 1982-83 year were \$2275 from Pamlico County and \$2014 from the state.

Districts are assisted and directed in their operations by the North Carolina Soil and Water Conservation Commission and the Division of Soil and Water Conservation in the Department of Natural Resources and Community Development. Such assistance takes a variety of forms: information on conservation practices, materials for education programs, training for district supervisors, etc. The Commission and Division are responsible for the state's overall soil conservation program, which emphasizes voluntary landowner action encouraged by a combination of education, technical assistance, and economic incentives.

Two other programs that touch on soil erosion problems in Pamlico County are:

- The Watershed or P.L. 566 Program, authorized by the Watershed Protection and Flood Prevention Act of 1954.⁹ This program provides financial and technical assistance to local organizations (including county governments

and soil and water conservation districts) for projects dealing with flood prevention, the conservation, utilization, or disposal of water, or the conservation and proper utilization of land. Projects are limited to watersheds less than 250,000 acres in size and must meet certain other restrictions. Through 1982, 110 applications for projects in North Carolina had been filed, of which 26 have been completed and 17 are awaiting or are under construction. Two projects were applied for in Pamlico County involving the construction of channels and dikes to promote better drainage. Both were approved for construction but later terminated before construction began.

- Federal low interest loans. Farmers Home Administration provides low interest loans to farmers, some of which (soil and water loans, farm operating loans, and farm ownership loans) can be used for installation of best management practices. The Small Business Administration provides some low-interest loans for soil and water conservation measures to qualifying farmers.

3.3 Water Quality Programs

Most current water quality management efforts originated with the Federal Water Pollution Control Act Amendments of 1972, which completely rewrote the federal law on water pollution control. Three provisions are of particular interest to agriculture and forestry: Title III, Section 208, and Section 404 (discussed later in this chapter).

Title III of the act authorized establishment of the National Pollutant Discharge Elimination System, or NPDES, program to regulate the discharges of most point sources of pollutants, including animal feedlots. EPA's feedlot regulations prohibit the discharge of process waste water pollutants, but the

size exemption is such that none of Pamlico County's livestock operations are subject to the law.

Of far greater importance is Section 208, which requires that all areas of a state be covered by an areawide waste treatment management plan that, among other things, includes

"a process to (i) identify, if appropriate, agriculturally and silviculturally related non-point sources of pollution, including return flows from irrigated agriculture, and their cumulative effects, runoff from manure disposal areas, and from land used for livestock and crop production, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources..."¹⁰

EPA, for its part, provided grants to state and areawide waste treatment management agencies to conduct these studies and published a series of reports providing guidance to these agencies. In the last several years, however, funding for 208 activities has been severely curtailed and the 208 program has languished. In response to prodding from states and to studies underscoring the importance of nonpoint sources, EPA is again showing interest in the 208 program, and there is sentiment in Congress, in connection with reauthorization of the Clean Water Act, to provide additional funds for 208 and possibly to give the program some teeth by setting implementation deadlines for states.

In response to the requirements of Section 208, the state completed its comprehensive water quality management plan in 1979. The plan is divided into subject areas; the agricultural portion was delegated to the Soil and Water Conservation Commission, which assembled a group called the 208 Agricultural Task Force to assist it, and the forestry portion was written by the Divisions of Environmental Management and Forest Resources.

Both plans examined a number of options for achieving water quality goals, and both selected a voluntary approach stressing education, technical assistance, and economic incentives to encourage the adoption of best

management practices. Since then a number of studies have been conducted in North Carolina to provide better water quality data and information on the effectiveness of best management practices. Implementation efforts have focused on improvements in the state's educational and technical assistance programs, but progress has been hampered by limited funding from both EPA and the General Assembly. The Department of Natural Resources and Community Development's budget request to the 1984 Short Session contains a comprehensive program for reducing nonpoint source pollution to nutrient sensitive waters that contains many of the elements that have been rejected on a statewide basis in previous years. These include additional funds for education and technical assistance, including two positions in the Division of Forest Resources that would concentrate solely on water quality concerns, and the state's first cost-sharing program for agricultural conservation practices. While these measures would not immediately benefit Pamlico County, the offices involved hope these programs will be expanded statewide in the future.

Two other programs have an impact on pollution from agricultural and forestry activities in Pamlico County. N.C. General Statutes §143-214.1 authorizes the Environmental Management Commission to classify the waters of the state and to adopt a series of water quality standards for each class. Four classes of fresh water and three classes of salt water have been established, each with standards for maximum concentrations of a variety of substances, including chlorophyll a (a measure of eutrophication), turbidity, coliform bacteria, and various pesticides. The standards have no regulatory enforcement effect themselves, but they do serve as a basis for other water quality control measures. Two of particular interest to agriculture and forestry are that (1) one of the standards for approval of CAMA permits in

estuarine areas of environmental concern is that the development will not violate any air and water quality standards, and (2) Section 401 of the Federal Water Pollution Control Act¹¹ requires that any applicant for a federal license or permit (such as a Section 10 or 404 permit) that may result in a discharge of pollutants into U.S. waters obtain a certification from the state water quality management agency stating that the discharge will comply with applicable effluent limitations and water quality standards. Thus those drainage projects requiring any of these permits must demonstrate that the discharge will not violate state water quality standards.

The Commission has also created a special class of "nutrient-sensitive" waters, with standards governing the discharge of nitrogen and phosphorus. At present only the Chowan River and Jordan and Falls Lakes are classified nutrient-sensitive, but the classification is available for application to other waters, including those in Pamlico County, if nutrient problems develop further. Of even greater interest, the Division of Environmental Management is now developing salinity standards for primary nursery areas. The proposed standards will identify an optimum salinity range, and later standards may address the rate of salinity change. The development of salinity standards for nursery areas presents serious difficulties because of the natural variability of such systems, and a great deal of work remains to be done on the technical application and enforcement options for such standards.

Also related to water quality is the program established under the N.C. Pesticide Law of 1971¹² to regulate the use, application, sale, and disposal of pesticides. The N.C. Pesticide Board is charged with administering the program, including the registration of pesticides and the annual licensing of pesticide dealers and applicators. Among other things, the law requires that

the Board's regulations must include all reasonable precautions to prevent injury by drift or misapplication to nontarget species and ecosystems.

3.4 Drainage and Water Management Programs

There are a number of programs at the federal, state, and local level concerned with specific drainage and water management needs, particularly in the outer coastal plain where high water tables are a major limitation on land use. Unlike soil erosion and water quality, however, there are no programs or institutions concerned with multi-purpose water management, and the current situation in Pamlico County is best described as benign anarchy. Drainage has been an integral part of the land development process in the county for two centuries, and an extensive drainage network of hundreds of miles of ditches and canals exists. But no agency or authority is responsible for ensuring that the network functions well as a system; landowners are free to tie into whatever drainage canals they have access to, and are individually responsible for maintaining the canals on their property. This approach has worked well and has met the needs of county landowners for many years, but recently problems have begun to be identified (such as freshwater and pollutant inputs to nursery areas) whose solutions are beyond the capability of individual landowners.

The programs and institutions that have helped to shape the existing drainage network are:

(1) The Drainage Acts. Chapter 156 of the North Carolina General Statutes provides a framework for establishing and maintaining drainage canals by individuals, corporations, and drainage districts. No drainage corporations or districts have been organized in the county, and as mentioned above, all canals and ditches are the responsibility of individual landowners.

(2) The Role of the Soil Conservation Service and the Agricultural Stabilization and Conservation Service. One of the major roles of SCS in Pamlico County over the years has been to provide technical assistance in the design of farmland drainage systems. The district conservationist assisted in the installation of roughly 60,000 feet of ditches in 1983 and almost 80,000 feet during the first half of 1984. Annual workloads during the boom years of the 1970's reached 200,000 feet. This assistance is not available throughout the county, however, as SCS, at the national level, eliminated the availability of technical assistance in draining many wetland types in the mid-1970's in response to growing concerns about wetland destruction.

For many years Agricultural Conservation Program cost-sharing funds were available for drainage improvements. In the late 1970's, however, ACP drew increasing criticism for funding practices that are primarily production oriented, and with the emphasis that the federal Soil and Water Resources Conservation Act of 1977 placed on priority conservation problems, the eligibility of drainage under ACP was eliminated.

Watershed (P.L. 566) funds are still available for drainage-related projects. As noted earlier, two such projects were approved for the county but were never constructed.

(3) Mosquito Control Program. Under the Authority of N.C. General Statutes §130A-346 and §130A-347, the state has provided matching funds to local governments for mosquito control. The major portion of Pamlico County's program over the years has focused on drainage improvements to eliminate the temporary pools where mosquitos breed, and many of the major canals in the county were constructed using program funds. During the early stages of the program some 430 miles of ditches in the county's coastal marshes were installed. As state and federal regulatory programs increasingly restricted

marsh operations in recent years, the program's focus shifted to upland drainage. The county's current contract with the state calls for approximately \$60,000 worth of upland ditching and snagging, as well as some spraying and surveillance.

The mosquito control program has been a controversial one, not only in Pamlico County but throughout the state, with charges that funds have been used for projects providing agricultural drainage but little mosquito control, and that the selection of projects has been politically and personally motivated. Partly due to this controversy, and partly due to the realization that most of the upland water management projects with mosquito control benefits have been completed, the county has chosen not to renew its contract with the state for upland water management, and this part of the program will end in 1984.

(4) Coastal/Wetland Regulatory Programs. Four regulatory programs, two state and two federal, influence the location and construction of drainage ditches and canals. Under the state's Dredge and Fill Act,¹³ a permit is required for any dredging or filling in estuarine waters, tidelands, marshlands, or state-owned lakes. Under the Coastal Area Management Act (CAMA),¹⁴ a permit is needed before undertaking any development (including dredging and filling) in any Area of Environmental Concern, including coastal wetlands and estuarine waters. Both programs are administered by the state's Office of Coastal Management. Jurisdiction under the two programs is essentially limited to proposals to construct or enlarge those portions of drainage canals passing through coastal wetlands or connecting with estuarine waters. Ditches emptying into other ditches are out of the programs' jurisdiction, unless the receiving ditch itself has become fish and wildlife

habitat with fringing wetlands (which is true of a few large canals in Hyde County).

General standards for the issuance of these permits require consideration of the project's impact on air and water quality, fish and wildlife, other estuarine resources, archaeological and historic resources, water supplies, and riparian owners. Specific CAMA use standards for drainage ditches cover spoil placement, the location of outlets, the size of ditches, and measures to reduce harmful inputs of fresh water, sediment, and nutrients. It has become state policy to deny permits for new outlets in primary nursery areas.

The two federal permit programs are those required by Section 10 of the Rivers and Harbors Act of 1899¹⁵ and Section 404 of the Federal Water Pollution Control Act Amendments of 1972,¹⁶ both administered by the Army Corps of Engineers. Under Section 10, a permit is needed for the connection of any drainage canal to navigable waters. Jurisdiction does not extend up the canal, but only to that portion connecting to navigable waters and passing through adjacent wetlands. Under Section 404, a permit is required for the discharge of dredged or fill material into navigable waters. The Corps interprets this jurisdiction as all waters and associated wetlands where the discharge is at least 5 ft³/second, regardless of whether the drainage channel is natural or artificial. The program applies only to discharges, though, so if the dredged material is deposited on an upland site, no permit is needed. The statute also exempts normal farming and forestry activities, including minor drainage, that are part of established operations, and ditch maintenance, but not drainage associated with the conversion of wetlands to agricultural and forestry use. Standards for the issuance of both permits require consideration of the public interest, wetlands, fish and wildlife, water quality, historic, cultural, scenic, and recreational values, and

neighboring properties and water resources projects. Administration of the 404 program with respect to drainage has been plagued by long delays and a lack of predictability in the handling of permits. To a large extent these problems have been cleared up, but a few issues remain unresolved.¹⁷

Two other state statutes deal with water management concerns: the Stream Obstruction Act,¹⁸ which prohibits the felling of trees or depositing of debris in streams so as to obstruct drainage, and the Water Use Act of 1967,¹⁹ which requires water withdrawals in excess of 100,000 gallons per day (including pumped drainage) within an existing capacity use area to be permitted by the Division of Environmental Management. No pumped drainage facilities of this size currently exist in Pamlico County.

It should be evident from Chapter Two and the discussion here that there are a variety of interests, including agriculture, forestry, wildlife, fisheries, mining, and mosquito control, that have a stake in how and when drainage occurs. Not surprisingly, these interests are sometimes in conflict. Recognizing that this was a growing problem, Governor Hunt appointed a Coastal Water Management Task Force in 1981 that brought the different interests together to reach a mutual understanding of the problems faced by each group and to formulate a balanced approach that would allow different sectors to develop in a mutually acceptable manner. The Task Force issued a final report in December, 1982, that included ten recommendations covering data needs, regulatory policies, water management planning and research, and education, technical assistance, and economic assistance for the adoption of best management practices. A committee was organized to oversee implementation of the recommendations, and an implementation status report was issued in February 1984.

3.5 Forest Management Programs

Several public programs have been established to improve forest management, particularly by small landowners. Their main purpose is to ensure an adequate supply of merchantable timber to meet the nation's needs, but they have also adopted a number of secondary objectives, including reduction of silvicultural sources of pollution and improved wildlife management.

Under the federal Forestry Incentives Program (FIP), authorized by the Cooperative Forestry Assistance Act of 1978,²⁰ cost-sharing assistance is available to small landowners for tree planting, site preparation for natural regeneration, and timber stand improvement (thinning, pruning, and release of seedlings and young trees from shade). Like ACP, the program is administered by the county ASC committee. Cost-share agreements between the landowner and USDA are based on a forest management plan developed by the landowner in cooperation with and approved by the N.C. Forest Service. Cost-share payments, now at 60%, will drop to 50% on July 1, and are limited to an annual maximum of \$10,000 per individual. FIP payments in Pamlico County in recent years have been:

1983	\$ 350
1982	4,698
1981	9,561

The Agricultural Conservation Program also provides cost-sharing for the same forestry practices and serves as a supplement to FIP, particularly for landowners who don't meet the ten acre minimum for FIP eligibility.

Substantial federal tax incentives for reforestation were created by P.L. 96-451 in 1981. Under this statute, the first \$10,000 of reforestation expenses in any year are eligible for a 10% investment tax credit and 7-year amortization.

Two important programs exist at the state level. Landowners may acquire technical assistance in forestry management through the Landowners Assistance Program.²¹ N.C. Forest Service employees in county and area offices throughout the state are available to provide free advice on reforestation, timber stand improvement, harvesting, and management to meet other landowner objectives, such as wildlife production. When requested, a forest management plan is provided to the landowner and may include recommendations for maintaining or improving water quality. The Forest Service's Pamlico County office, which employs a county forest ranger, an equipment operator, and one or more part-time fire watchers, is supported jointly by state and county funds.

Under the Forest Development Program,²² state cost-sharing assistance is available for reforestation and release of seedling and sprouts. Work must conform to a management plan approved (and usually written) by the N.C. Forest Service. The cost-share rate, now 50%, will drop to 40% on July 1, and payments are limited to 100 acres per year. Federal and state cost-share payments cannot be applied to the same acreage.

The Forestry Extension division of the Agricultural Extension Service employs several forestry extension specialists who conduct meetings and demonstrations, help disseminate research results, and in other ways work to improve forest management in the state.

Finally, some wood products corporations such as Weyerhaeuser provide technical assistance and even seedlings to small landowners, in return for preferential rights to purchase the timber or land if the owner ever offers either for sale.

FOOTNOTES

1. Soil Conservation Service, U.S. Dept. of Agriculture, Potential Best Management Practices To Control Sediment Non-Point Source Pollution From Agricultural Land in North Carolina (Raleigh: SCS, 1978).
2. Division of Forest Resources, N.C. Dept. of Natural Resources and Community Development, Forest Practices Guidelines Related to Water Quality (Raleigh: Division of Forest Resources, n.d.).
3. Division of Environmental Management, N.C. Dept. of Natural Resources and Community Development, Water Quality and Forestry, A Management Plan (Raleigh: Division of Environmental Management, 1979), p. 24.
4. Bureau of the Census, 1982 Census of Agriculture, Preliminary Report, Pamlico County, N.C. (Washington, D.C.: U.S. Dept. of Commerce, 1984).
5. P.L. 74-46, 16 U.S.C. §§590a-f.
6. 7 CFR 610.2.
7. P.L. 74-461, 16 U.S.C. §§590g-q.
8. N.C.Gen. Stat. Ch. 139.
9. P.L. 83-566, 16 U.S.C. §§1001-1009.
10. P.L. 92-500, Section 208, 33 U.S.C. §1288.
11. 33 U.S.C. §1341.
12. N.C.Gen. Stat. §143-434 to §143-470.
13. N.C. Gen. Stat. §113-229.
14. N.C. Gen. Stat. §113A-100 et seq.
15. 33 U.S.C. §403.
16. 33 U.S.C. § 1344.
17. See the Governor's Coastal Water Management Task Force Report, 1984, pp. 4-5.
18. N.C. Gen. Stat. §§77-13,14.
19. N.C. Gen. Stat. §143-215.11 et seq.
20. P.L. 95-313, 16 U.S.C. §2103.

21. N.C. Gen. Stat. §113-81.2; 15 NCAC 9C .0900.

22. N.C. Gen. Stat. §113A-176 to §113A-183; 15 NCAC 9C .0900.

Chapter Four
RECOMMENDATIONS

4.1 County Policy

Agriculture and forestry are two of the leading industries in Pamlico County and together, directly and indirectly, account for a substantial portion of the county's employment and income. As discussed above, however, certain agricultural and forestry practices may have various adverse environmental impacts on the county, including excessive soil erosion, increased saltwater encroachment, reductions in the supply of wildlife and natural areas, reduction in forest growing stock, freshwater inflow to primary nursery areas, and increased inputs of sediment, nutrients, bacteria, and pesticides to estuaries. These impacts, in turn, can reduce the long-term productivity of the agricultural, forestry, and fisheries sectors upon which the county's economy depends, and also cause a deterioration in environmental quality that will make the county a less satisfying place to live. While the state and federal governments have instituted programs to address many of these concerns, the county cannot rely solely on such programs to fully protect its environment. It is important that the county take reasonable and appropriate steps on its own initiative to help reduce or eliminate these harmful practices.

Recommendation: Pamlico County should adopt the following policy for inclusion in its land use plan: The County recognizes the importance of agriculture, forestry, and fisheries in the economy and life of the county and the importance of a high quality natural environment to county residents. Certain agricultural and forestry practices may have adverse impacts on the

long-term productivity of the land, on the productivity of estuarine waters, and on the environmental health of the county. It is County policy to support the modification or elimination of these deleterious practices, so as to ensure the long-term productivity of the county's resource base and to protect the quality of life of county residents.

4.2 Education, Technical Assistance, and Economic Incentives

Education, technical assistance, and economic incentives are the cornerstones of the voluntary approach the state has taken to deal with agricultural and forestry erosion and nonpoint pollution. More could be done in each of these areas, particularly at a time when inflation-adjusted funding levels for federal conservation programs have been steadily declining and when the current administration is seeking further major cuts (the President's fiscal year 1985 budget proposes a 63% cut in ACP funding alone).

An increased level of county funding support for these efforts could take several forms:

(1) Additional manpower beyond the two full-time resource conservation personnel currently employed in the county (the SCS district conservationist and county forest ranger). Both of these people expressed a need for more help in education and technical assistance work, particularly to reach out to people not aware of or for other reasons not making use of available conservation services. An additional position could be added to county staff, could be "lent" to the conservation district or Forest Service under a memorandum of understanding, or could be added directly by one of the latter two agencies using county appropriations. There are also possibilities for

sharing a position or for part-time assignment of an otherwise unrelated position.

(2) Additional funds for specific projects, undertaken by the county, the conservation district, or the Forest Service. For instance, there is a pressing need for demonstration farms and forests in the county to illustrate the feasibility and benefits of best management practices.

(3) Financial incentives for the adoption of best management practices. There are three basic types of financial incentives: tax incentives, cost sharing, and low interest loans. The county has no authority to offer tax incentives, as the power to create special classes of property eligible for reduced assessment rates rests solely with the General Assembly. Cost sharing and low interest loans could be provided through the county or conservation district. Any incentives program should be highly focused or "targeted." It should be limited to the one or two practices the county considers most effective in reducing impacts, or only to practices in certain areas, such as those adjacent to primary nursery areas. Sedimentation ponds on drainage canals and pumped drainage through wetland areas are examples.

No attempt has been made to estimate the cost-effectiveness of these different options or to identify specific ones to recommend for funding. That would require a level of effort and detail that is beyond the scope of this study. Nor is this a recommendation for a diffuse, throw-money-at-the-problem approach; the county does not have the tax base to spare. What is recommended is a willingness to fund requests for highly specific, highly targeted conservation programs and measures that offer a good chance of success.

Recommendation: The County should consider additional funding for specific projects and manpower needs in resource conservation that have a strongly demonstrated need and a high probability of success.

4.3 Support for the Bay River Soil and Water Conservation District

The Bay River Soil and Water Conservation District is an underutilized resource. Soil and water conservation districts in North Carolina have the status of distinct units of local government, with substantial authority and a single charge: to promote and improve the conservation of soil, water, and related resources within their jurisdictions. They are the only units of local government with major, explicit environmental responsibilities. They have the potential to provide leadership on a full range of issues of concern to county residents. Pamlico County, through consultation, joint program sponsorships, shared resources, and other forms of assistance, can help the Bay River District to realize this potential.

The county should encourage the district to become more aggressive, both in seeking additional sources of funding (county expertise would be helpful here), and in developing additional expertise and programs for both the agricultural community and other interests. Twenty-five districts in Ohio, for instance, currently have grants from federal and state environmental protection agencies. Additional funds would permit the district to hire its own professional staff, which would further help the district in establishing a strong identity.

The county should also encourage the district to reach out and broaden its base of support, and to evolve from an agency that speaks primarily for the agricultural community to one that is more representative of the full range of interests in the county, including those of the fishing and residential development sectors. Such a change would help build public support for its programs and would probably enhance its effectiveness in dealing with conflicting interests and in obtaining additional funding.

The county should seek a closer working relationship with the district. This would help build a base of mutual trust and responsibility that would eventually allow the county and district to work cooperatively on a full range of conservation issues. It is in the county's interest to help build a strong district, one that in some ways can be more effective than the county in maintaining a high quality natural environment.

Recommendation: The County should develop a closer working relationship with the Bay River Soil and Water Conservation District, and should encourage and assist the District in expanding its scope and funding support and in becoming a more aggressive advocate of resource conservation.

4.4 Cross-Compliance

The term "cross-compliance" refers to the notion that landowners and operators who receive the benefit of government subsidies, particularly USDA's commodity programs, should be required to comply with soil and water conservation standards. Cross-compliance is currently a popular idea among policy makers. An excellent example is the so-called Sodbuster Bill currently in Congress. If enacted, this bill would eliminate federal price supports, loans, and crop insurance for farmers who "sodbust," or convert fragile and highly erodible grassland to row crop cultivation. Examples at the state level include several states that require conservation elements in state land leases.

The best opportunity to apply this approach in North Carolina is in connection with use-value property tax assessment. N.C. Gen. Stat. §105-277.2 to §105-277.7 provides for property tax assessment at use-value, rather than market value, for qualifying agricultural, horticultural, and forest land. Similar provisions have been enacted in many other states. Their purpose is

to prevent high property taxes from forcing landowners to sell their agricultural or forest land or forcing them to convert it to other uses, particularly urban development.

In 1983 several thousand acres were enrolled in the use-value program in Pamlico County, resulting in a reduction in assessment value of \$3,098,681, and (at a 74¢ tax rate) a revenue loss to the county of \$22,900. The county might legitimately expect that, in return for helping landowners preserve their agricultural and forest land, landowners should use proper conservation practices to assure the continued productivity and value of this land.

There are several forms such cross-compliance could take. At a minimum, landowners enrolled in the use-value program could be required to obtain a conservation plan from the SCS or a forest management plan from the Forest Service. This amounts to "mandatory education." A stricter form requires that the conservation plan or forest management plan be adhered to. While certainly more effective, this approach also creates monitoring and enforcement problems.

Rhode Island and several counties in Washington now require the development of conservation plans before individual farmers are eligible for use-value property tax assessment. Pamlico County should request the General Assembly to provide enabling legislation for counties to impose similar restrictions.

Recommendation: The County should request the General Assembly to provide counties with the ability to require conservation plans or the installation of appropriate conservation treatments as a condition of eligibility for use-value property tax assessment.

4.5 Water Management

As noted before, there is a great diversity of interests in water management. Farmers are anxious to remove water rapidly most of the year, but there is also some exciting research being conducted in Pamlico County and other coastal plain counties on the maintenance of high water tables in summer for subsurface irrigation. Foresters need good drainage for harvest and seedling establishment and moderate drainage at other times, but are also interested in using high water tables during forest fire seasons to reduce fire hazard. Drainage may affect saltwater encroachment into freshwater aquifers. Research has been conducted on the use of maintaining high water tables in winter to promote denitrification and reduce nitrate losses. Fishermen are concerned about freshwater inflow to nursery areas, and hunters about the loss of wetland habitat. Peat miners and health officials concerned with mosquito control have their own drainage interests.

Conflicts between these interests are becoming more common. State government has responded, most notably with the effort of the Governor's Coastal Water Management Task Force. There is currently a great deal of interest among state agencies in innovative water management schemes that help resolve these growing conflicts, and funding is or may be available from a variety of sources for research and for demonstration projects.

What is lacking is a single person or agency at the local level that is responsible for working with these different interests, who can work to construct compromises and to fashion the kinds of multi-purpose water management projects that will point the way to long-term solutions. What is needed is some one or group to help pull together existing knowledge and apply it to Pamlico County, to take advantage of the variety of funding sources

available, and in general to focus some of the energy and resources generated at the state level on specific water management issues in the county.

It is recommended that the County propose the formation of an ad hoc county water management task force. Membership would include the various groups with water management concerns: the soil and water conservation district, SCS, county forest ranger, county health department, the Farm Bureau, the Fisheries Association, etc. The county should provide a chairman and some staff time. The task force would follow developments in the field, interact with the state, provide a forum for resolving conflicts, help plan projects, and in general promote integrated water management in the county. The different interest groups have been interacting at the state level for several years, and the time would seem to be right for bringing together local interests to deal with the problem. Preparation and implementation of a comprehensive water management plan for the county should be the group's long-term goal, and it is not too soon to begin fashioning the consensus and building up the knowledge and expertise that this project will require.

Recommendation: The County should initiate formation of an ad hoc county water management task force to bring together the disparate local interests in water management and to begin work towards a comprehensive water management plan for the county.

