2012 Annual Progress Report on the Tar-Pamlico Agricultural Rule
(15 A NCAC 02B.0256)
A Report to the NC Environmental Management Commission
From the Tar-Pamlico Basin Oversight Committee
Crop Year 2011

Summary

The Tar-Pamlico Basin Oversight Committee (BOC) received and approved crop year (CY) 2011 annual reports from the fourteen Local Advisory Committees (LACs) operating under the Tar-Pamlico Agricultural Rule as part of the Tar-Pamlico Basin Nutrient Management Strategy. The report demonstrates agriculture's ongoing collective compliance with the Tar-Pamlico Agricultural Rule and estimates further progress in decreasing nutrient losses. In CY2011, agriculture collectively achieved an estimated 43% reduction in nitrogen loss compared to the 1991 baseline, continuing to exceed the rule-mandated 30% reduction. This represents a 6% decrease in reduction compared to the 49% reduction reported for CY2010. Eleven of the 14 LAC's exceeded the mandated 30% reduction goal.

Rule Requirements and Compliance History

Effective September 2001, the Tar-Pamlico Nutrient Sensitive Waters Management Strategy (NSW) provides for a collective strategy for farmers to meet the 30% nitrogen loss reduction and no-increase phosphorus goals within five years. A BOC and fourteen LACs were established to implement the rule and to assist farmers with complying with the rule. Currently there are five full time technicians that work with LACs to coordinate information for the annual reports. They are funded by the EPA 319 grant program, NC Agriculture Cost Share Program (ACSP) technical assistance funds, and county funds.

Tar-Pamlico NSW Strategy

The Environmental Management Commission (EMC) adopted the Tar-Pamlico nutrient strategy in 2000. The NSW strategy goal is to reduce the average annual load of nitrogen to the Pamlico estuary by 30% from 1991 levels and to limit phosphorus loading to 1991 levels. Mandatory controls were applied to addressing non-point source pollution in agriculture, urban stormwater, nutrient management, and riparian buffer protection. The management strategy built upon the precedent-setting Neuse River Basin effort established three years earlier, which for the first time set regulatory reduction measures for nutrients on cropland acres in the state.

All fourteen LACs submitted their first annual report to the BOC in November 2003, which collectively estimated a 39% nitrogen loss reduction, and 10 of 14 LACs exceeded the 30% individually. Collective reductions had gradually increased in succeeding years, and by CY2007 only one LAC was shy of the 30% individually. In CY2008 all LACs individually exceeded the 30% nitrogen loss reduction goal and have continued to do so through CY2010. While the collective reduction of 43% for CY 2011exceeds the mandated 30%, three individual LAC's fell below the 30% goal (Edgecombe, Halifax, and Martin).

Scope of Report and Methodology

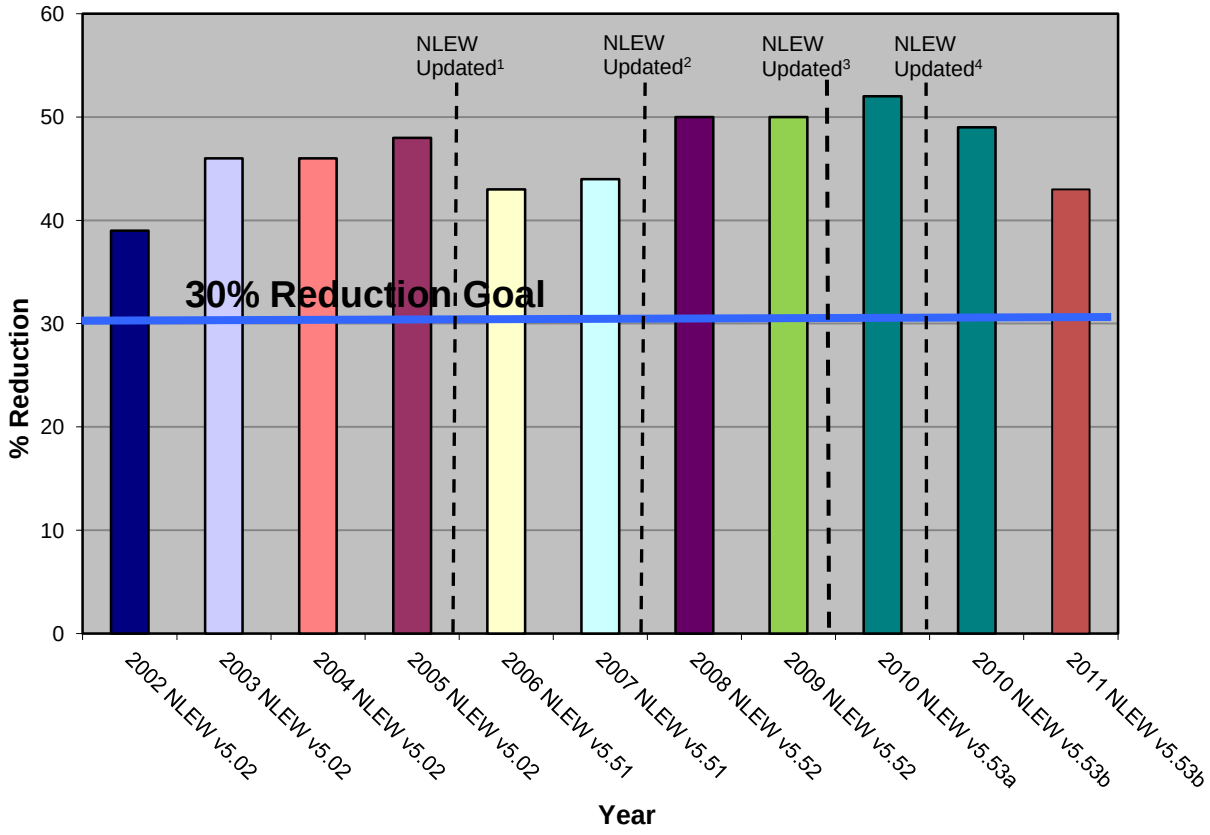
The estimates provided in this report represent whole-county scale calculations of nitrogen loss from cropland agriculture in the basin made by soil and water conservation district technicians using the 'aggregate' version of the Nitrogen Loss Estimation Worksheet, or NLEW, an

accounting tool developed to meet the specifications of the Neuse Rule and approved by the EMC for use in the Tar-Pamlico Basin. The development team included interagency technical representatives of the NC Division of Water Quality (DWQ), NC Division of Soil and Water Conservation (DSWC), USDA-NRCS and was led by NC State University Soil Science Department faculty. NLEW captures application of both inorganic and animal waste sources of fertilizer to cropland. It does not capture the effects of managed livestock on nitrogen movement, including pastured, confined, and non-commercial livestock. NLEW is an "edge-of-management unit" accounting tool; it estimates changes in nitrogen loss from croplands, but does not estimate changes in nitrogen loading to surface waters. An assessment method was developed for phosphorus, approved by the EMC, and is described later in the report.

Annual Estimates of N Loss and the Effect of NLEW Refinements

As discussed below, the NLEW software is periodically revised to incorporate new knowledge gained through research and improvements to data. These changes have incorporated the best available data, but changes to NLEW must be considered when comparing nitrogen loss reduction in different versions of NLEW. Further updates in soil management units are expected as NRCS produces updated electronic soils data. The small changes in soil management units are unlikely to produce significant effects on nitrogen loss reductions. In 2010 nitrogen reduction efficiencies assigned to buffers in NLEW were significantly decreased (see Table 1). Figure 1 represents the annual percent nitrogen loss reduction from 2002 to 2011.

Figure 1. Collective Nitrogen Loss Reduction Percent 2002 to 2011, Tar Pamlico River Basin.



[1]Between CY2005 & CY2006 NLEW was updated to incorporate revised soil management units and buffer nitrogen reduction efficiencies were reduced.
[2]Between CY2007 & CY2008 NLEW was updated to incorporate revised soil management units and correct some realistic yield errors.
[3]Between CY2009 & CY2010 NLEW was an administration software update with no effect on accounting.
[4]In 2011 NLEW was updated to significantly decrease buffer N removal efficiencies; CY2010 and the baseline reductions were recalculated to reflect changes in NLEW.

The first revision (v5.51) marked a significant change in the nitrogen reduction efficiencies of buffers so both the baseline and CY2005 were re-calculated based on the best available information. The second (v5.52) and third (v5.53a) revisions were administrative along with minor updates of soil mapping units. In April of 2011 the NLEW Committee established further reductions (v5.53b) in N removal efficiencies for buffers based on additional research. Table 1 lists the changes in buffer N reduction efficiencies over time.

Table 1. Changes in buffer width options and Nitrogen reduction efficiencies in NLEW

Buffer Width	NLEW v5.02* % N Reduction	NLEW v5.51 % N Reduction	NLEW v5.53b % N Reduction
20'	40% (grass)	30%	20%
20'	75% (trees & shrubs)	n/a	n/a
30'	65%	40%	25%
50'	85%	50%	30%
70'	n/a	55%	n/a
100'	n/a	60%	35%

**NLEW v5.02 - the vegetation type (ie trees, shrubs, grass) within 20' and 50' buffers determined reduction values. Based on research results, this distinction was dropped from subsequent NLEW versions.*

Since the release of the CY2010 Report to the EMC, baseline and CY2010 values have been recalculated to reflect the most recent decrease in N removal efficiencies of buffers in NLEW. This resulted in a decreased estimate of percent N removed from agricultural loss for CY2010 to 49%, down from the reported 52%.

Current Status
Nitrogen Reduction from Baseline for CY2011

All fourteen LACs submitted their ninth annual report to the BOC in September 2012. For the entire basin, in CY2011 agriculture achieved a 43% reduction in nitrogen loss compared to the 1991 baseline. This year 11 of the 14 LACs achieved the at-least 30% nitrogen loss reduction goal individually. Table 2 lists each county's baseline, CY2010 and CY2011 nitrogen (lbs/yr) loss values, and nitrogen loss percent reductions from the baseline in CY2010 and CY2011.

Table 2. Estimated Reductions in Agricultural Nitrogen Loss from Baseline (1991) for CY2010 (NLEW v5.53a & b) and CY2011 (NLEW v5.53b), Tar-Pamlico River Basin

County	Recalculated Baseline N Loss (lb)[1] NLEW v5.53b	CY2010 Reported N Loss (%)[2] NLEW v5.53a	Recalculated CY2010 N Loss (lb) NLEW v5.53b	Recalculated CY2010 N Loss (%) NLEW v5.53b	CY2011 N Loss (lb) NLEW v5.53b	CY2011 N Loss (%) NLEW v5.53b
Beaufort	9,190,250	42%	5,452,562	41%	6,014,967	35%
Edgecombe	5,037,628	40%	3,183,913	37%	3,651,075	28%
Franklin	2,183,751	72%	722,189	67%	798,686	63%
Granville	890,371	57%	456,089	49%	449,968	49%
Halifax	2,806,652	42%	1,679,575	40%	2,199,533	22%
Hyde	4,975,781	42%	3,100,999	38%	3,289,265	34%
Martin	782,152	43%	519,235	34%	595,684	24%
Nash	4,963,538	65%	1,746,221	65%	1,547,934	69%
Person	153,228	77%	38,208	75%	52,799	66%
Pitt	6,147,727	67%	2,271,194	63%	2,646,294	57%
Vance	419,485	73%	144,527	66%	165,056	61%
Warren	535,517	76%	179,217	67%	148,874	72%
Washington	977,801	39%	608,935	38%	674,271	31%
Wilson	890,961	50%	437,878	51%	545,946	39%
Total	39,954,842	52%	20,540,742	49%	22,780,352	43%

[1]*Nitrogen loss values are for comparative purposes. They represent nitrogen that was applied to agricultural lands in the basin and neither used by crops nor intercepted by BMPs in a Soil Management Unit, based on NLEW calculations. This is not an in-stream loading value.*
[2]*CY2010 N loss percentages are values from the pre-revised NLEW (v5.53a) 2011Report, shown here to compare to the recalculated CY2010 NLEW (v5.53b) values used in this 2012 Report.*

Halifax, Martin and Edgecombe Counties' individual nitrogen reductions dropped below the 30% goal, to 22%, 24% and 28%, respectively, due mostly to cropping shifts. These three counties combined saw cotton increase by 33,232 acres while soybeans and peanuts, which need no nitrogen application, decreased by 37,322 acres (see Table 3). Halifax County saw total cropland increase by 1,839 acres, an 11,733 acre increase in cotton, and soybeans and peanuts decrease by 9,367 acres. The BOC will focus its efforts to work with these LAC's on their reductions.

Table 3. Cropping shifts within Halifax, Martin and Edgecombe Counties

County	Acreage Difference - 2010 to 2011					
	Ag. acres	cotton (ac)	corn (ac)	soybeans/peanuts (ac)	tobacco (ac)	wheat (ac)
Halifax	1,839	11,773	-1,566	-9,367	551	483
Martin	-324	2,235	-1,184	-1,245	76	415
Edgecombe	-744	19,224	-6,242	-26,710	1,062	-797
Totals	771	33,232	-8,992	-37,322	1,689	101

Nitrogen loss reductions were achieved through the combination of fertilization rate decreases, cropping shifts, BMP implementation and cropland attenuation shown in Table 4. The most significant factor continues to be fertilization management. NLEW estimates these factors contributed to the total nitrogen loss reduction in the following manner:

Table 4. Factors that Influence Nitrogen Reduction by Percentage on Agricultural Lands, Tar-Pamlico River Basin*

Factor	CY2008 NLEW v5.52	CY2009 NLEW v5.52	CY2010 NLEW v5.53b	CY2011 NLEW v5.53b
BMP implementation	10%	11%	9%	9%
Fertilization Management	21%	20%	23%	17%
Cropping shift	10%	11%	10%	8%
Cropland converted to grass/trees	4%	3.50%	3%	3%
Cropland lost to idle land	4%	3.50%	3%	4%
Cropland lost to development	1%	1%	1%	1%
TOTAL	50%	50%	49%	43%

**Percentages are based on a total of the reduction, not a year-to-year comparison.*

BMP Implementation

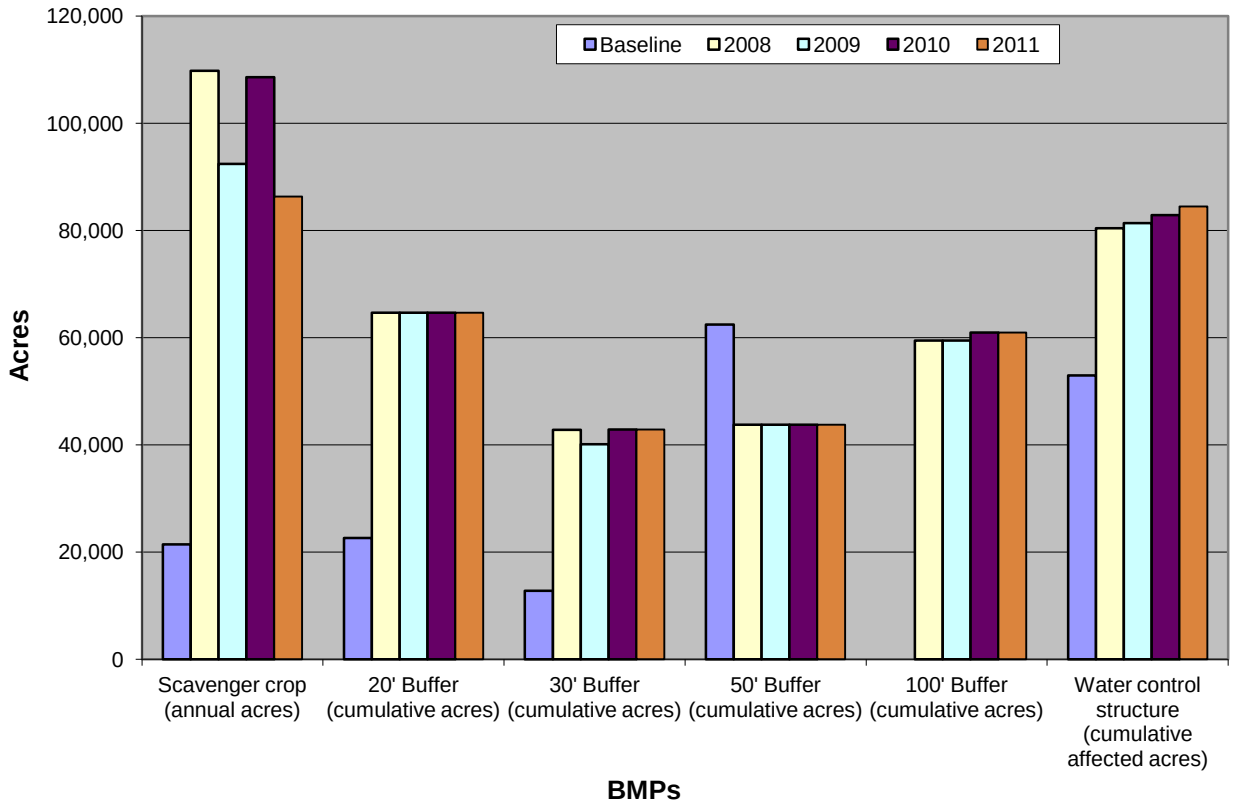
As illustrated in Figure 2, CY2011 yielded a net increase of 1,598 acres affected by water control structures and a decrease in acres of nutrient scavenger crops, while buffer acres remained relatively steady.

While there is the inherent opportunity for variability in the data reported, LACs are including data that is the best information currently available. As additional sound data sources become available, the LACs will review the sources and update their methodology for reporting if warranted.

Overall, the total acres of implementation of BMPs have increased since the baseline, as illustrated in Figure 2. Based on a comparison of the actual acres of BMPs installed through federal, state and local cost share programs to the total 721,432 cropland acres; over half of all reported croplands receive some kind of treatment by BMPs. However this treatment estimate does not take into account the entire drainage area treated by buffers in the piedmont which is generally 5 to 10 times higher than the actual acres of the buffer shown in Figure 2. (Bruton 2004)[1]

[1] **Bruton, Jeffrey Griffin. 2004. Headwater Catchments: Estimating Surface Drainage Extent Across North Carolina and Correlations Between Landuse, Near Stream, and Water Quality Indicators in the Piedmont Physiographic Region. Ph.D. Dissertation. Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27606.http://www.lib.ncsu.edu/theses/available/etd-03282004-174056/**

Figure 2: Nutrient Reducing BMPs installed on Agricultural Lands for Baseline (1991) and 2008-2011, Tar-Pamlico River Basin*



**The acres of buffers listed represent actual acres. Acres affected by the buffer could be 5 to 10 times larger than the acreage shown above.*

Additional Nutrient BMPs

Not all types of nutrient-reducing BMPs are tracked by NLEW. These include: livestock-related nitrogen and phosphorus reducing BMPs, BMPs that reduce soil and phosphorus loss, and BMPs that do not have enough scientific research to support estimating a nitrogen benefit. The BOC believes it is worthwhile to recognize these practices. Table 5 identifies BMPs not accounted for in NLEW and tracks their implementation in the Basin since CY2005.

Increased implementation numbers are evident in CY2011 across all BMP types since the baseline. These BMPs will yield reductions in nitrogen loss that are not reflected in the NLEW accounting in this report but will benefit the estuary.

Table 5: Nutrient-Reducing Best Management Practices Not Accounted for In NLEW, 2008-2011, Tar-Pamlico River Basin*

BMP	Units	2001	2008	2009	2010	2011
Diversion	Feet	176,797	388,920	389,861	390,046	394,461
Fencing (USDA Programs)	Feet	na	129,498	205,959	206,190	235,865
Field Border	Acres	118	471	539	943	1,001
Grassed Waterway	Acres	314	639	646	1,115	1,154
Livestock Exclusion	Feet	21,662	217,302	217,302	221,088	221,096
Sod Based Rotation	Acres	1,337	17,847	16,724	26,504	37,052
Tillage Management	Acres	936	31,421	33,905	35,946	40,612
Terraces	Feet	206,560	352,819	368,914	369,914	371,936

**Values represent active contracts in State and Federal cost share programs. The federal information was not included prior to CY2007.*

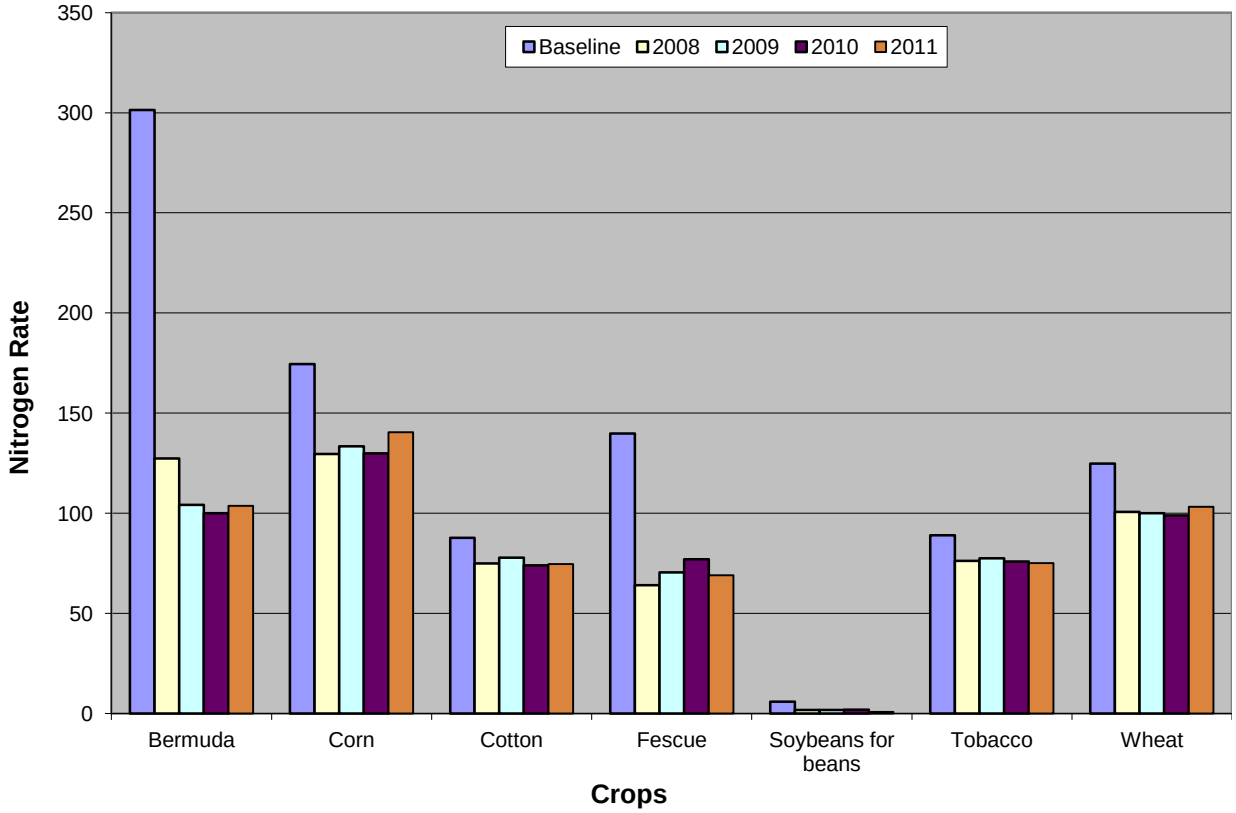
Fertilization Management

Both increased fertilizer cost and better nutrient management have resulted in farmers in the Tar-Pamlico River Basin reducing their nitrogen application from baseline levels. Figure 3 indicates that nitrogen rates for the major crops in the basin have reduced from the baseline period. In CY2011 nitrogen rates increased for corn compared to CY2010, and only slightly so for bermuda grass and wheat. The rates for tobacco and fescue slightly decreased, while the rates for soybeans and cotton remained constant. Most pastures are under fertilized throughout the Tar-Pamlico basin. Some bermuda grass and fescue land is used for waste application, but due to the nitrogen concentrations of the waste and the amount of liquid, actual waste applied does not have nitrogen application rates as high as the agronomic rates for the grasses. The pasture and hayland are typically not supplemented with inorganic fertilizers. Fertilizer rates are revisited annually by LACs using data from farmers, commercial applicators and state and federal agencies' professional estimates.

Factors Identified by LACs Contributing to Reduced Nitrogen Rates since the Baseline Year

- Rising fertilizer costs and fluctuating farm incomes.
- Increased education & outreach on nutrient management (NC Cooperative Extension holds an annual nutrient management training session, since 2004 approximately 2,000 farmers and applicators have received training.)
- Mandatory waste management plans
- The federal government tobacco quota buy-out reducing tobacco acreage.
- Neuse & Tar-Pamlico Nutrient Strategies.

Figure 3. Average Annual Nitrogen Fertilization Rate (lb/ac) for the Major Agricultural Crops for the Baseline (1991) and 2008-2011, Tar-Pamlico River Basin

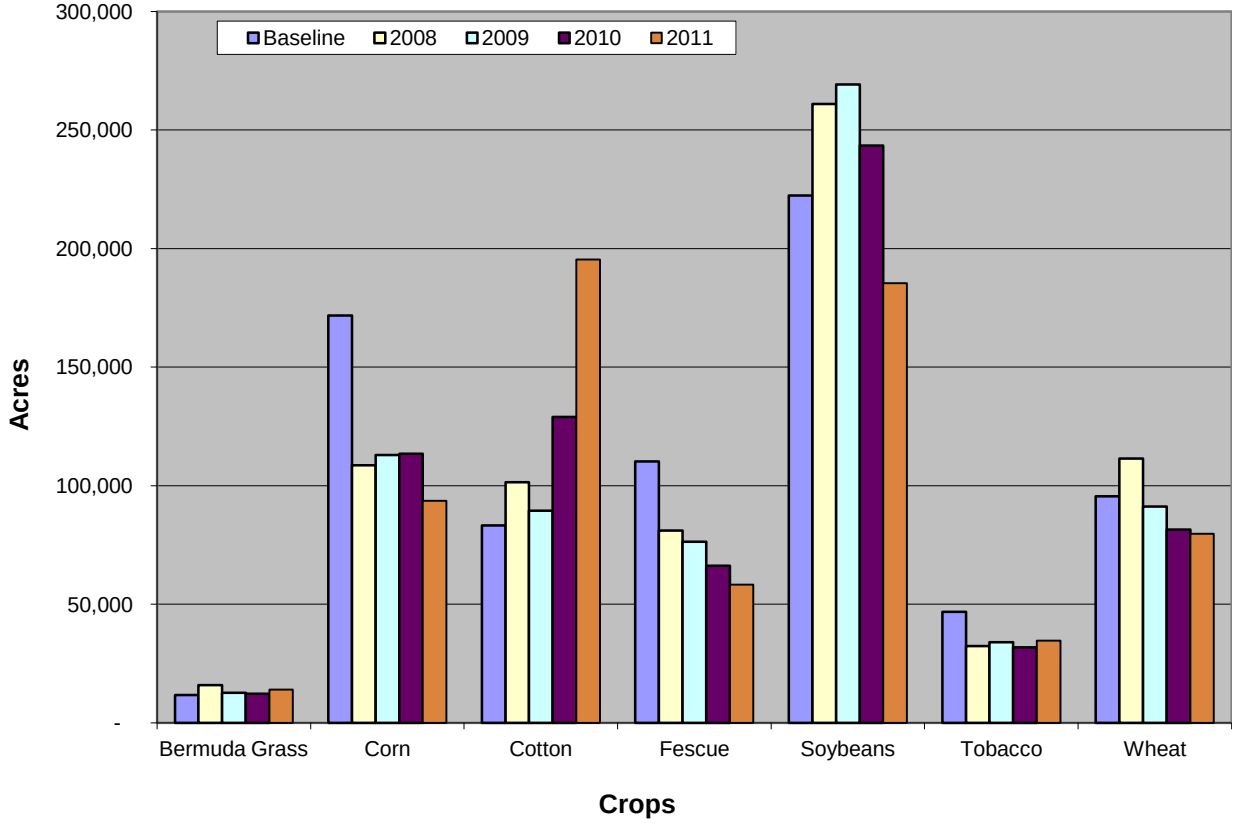


Cropping Shifts

The LACs calculated the cropland acreage by utilizing crop data reported by farmers to the USDA-Farm Service Agency. Each crop requires different amounts of nitrogen and use the nitrogen applied with different efficiency rates. Changes in the mix of crops grown can have a significant impact on the cumulative yearly nitrogen loss reduction.

Figure 4 shows crop acres and shifts for the last four years compared to the baseline. While some crops – bermuda grass and tobacco – have remained relatively stable, others show more volatility. Between CY2009 and CY2011, cotton has shown the largest increase in acres while soybeans, wheat, corn and fescue have lost significant acreages. Cotton acreage increased from 89,470 in 2009 to 195,450 acres in 2011. A host of factors from individual to global determine crop choices.

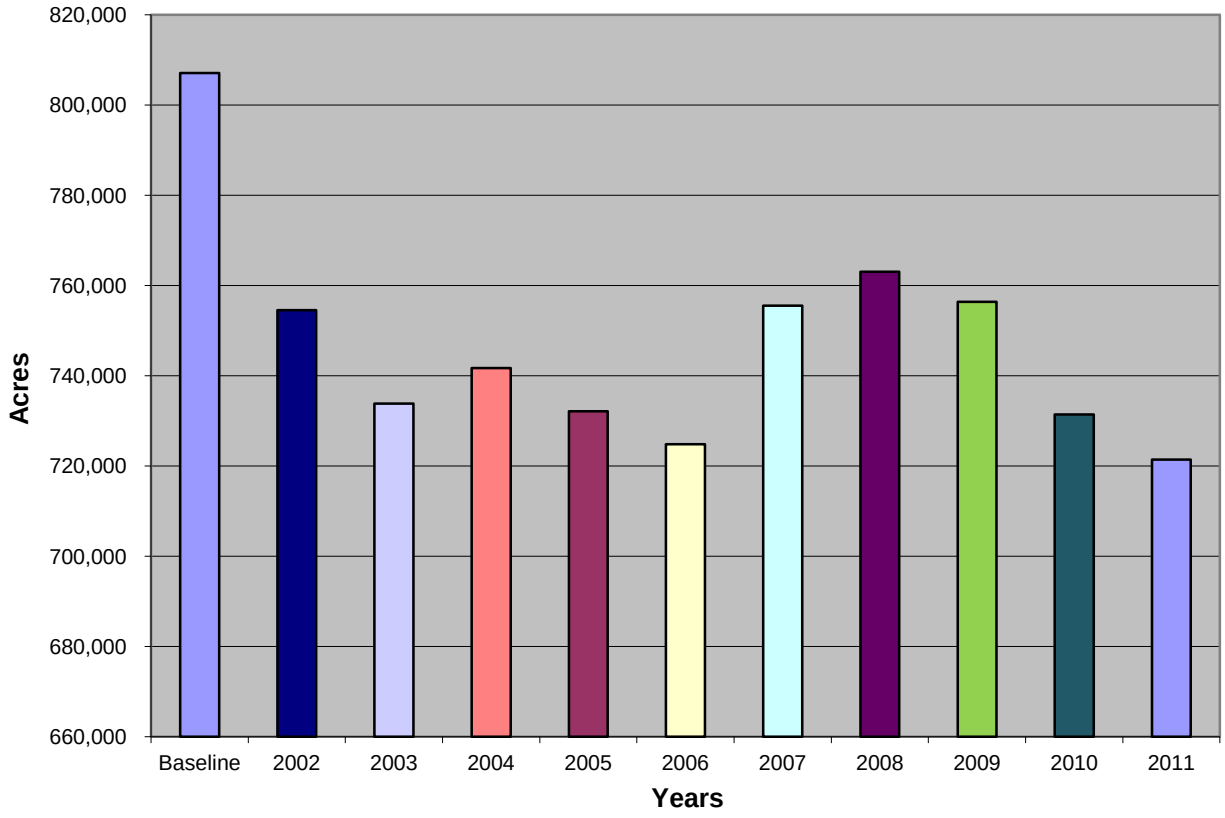
Figure 4. Acreage of Major Crops for the Baseline (1991) and 2008-2011, Tar-Pamlico River Basin



Land Use Change to Development, Idle Land and Cropland Conversion

The number of cropland acres fluctuates every year in the Tar-Pamlico River Basin due to cropland conversion, idle land and development. Each year, some cropland is permanently lost to development or converted to grass or trees and likely to be ultimately lost from agricultural production. Idle land is agricultural land that is currently out of production but could be brought back into production at any time. Currently it is estimated that approximately 10,441 acres have been permanently lost to development in the basin and more than 31,631 acres have been converted to grass or trees since the 1991 baseline. For CY2011 it is estimated that there are approximately 39,130 idle acres and a total of 721,432 total acres of cropland (see Fig. 5). These estimates come from the LAC members' best professional judgment, USDA-FSA records and county planning department data.

Figure 5. Total Cropland Acres in the Tar-Pamlico River Basin, Baseline (1991) and 2002-2011



Phosphorus

Phosphorus Indicators for CY2011: The qualitative indicators included in Table 6 show the relative changes in land use and management parameters and their relative effect on phosphorus loss risk in the basin. This approach was recommended by the Phosphorus Technical Advisory Committee (PTAC) in 2005 due to the difficulty of developing an aggregate phosphorus tool parallel to the nitrogen NLEW tool. Table 6 builds upon the data provided in the 2005 PTAC report, which included all available data at the time ending with data from 2003. This report adds phosphorus indicator data for CY2007 through CY2011. Most of the parameters indicate less risk of phosphorus loss than in the baseline.

Contributing to the reduced risk of phosphorus loss is the increase of nutrient reducing BMPs in the basin. As indicated in Table 6, the acres affected in the basin by vegetated buffers and water control structures have steadily increased over the past three years. It should also be noted that the soil test phosphorus median number

Phosphorous Technical Assistance Committee (PTAC)

The PTAC's overall purpose was to establish a phosphorus accounting method for agriculture in the basin. It determined that a defensible, aggregated, county-scale accounting method for estimating phosphorus losses from agricultural lands is not currently feasible due to "the complexity of phosphorus behavior and transport within a watershed, the lack of suitable data required to adequately quantify the various mechanisms of phosphorus loss and retention within watersheds of the basin, and the problem with not being able to capture agricultural conditions as they existed in 1991". The PTAC instead developed recommendations for qualitatively tracking relative changes in practices in land use and management related to agricultural activity that either increase or decrease the risk of phosphorus loss from agricultural lands in the basin on an annual basis.

reported for the basin fluctuates each year due to the nature of how the data is collected and compiled. The soil test phosphorus median numbers shown in Table 6 are generated by using North Carolina Department of Agriculture and Consumer Services (NCDA&CS) soil test laboratory results from voluntary soil testing and the data is reported by the NCDA&CS. The number of samples collected each year varies. The data does not include soil tests that were submitted to private laboratories. The soil test results from the NCDA&CS database represent data from entire counties in the basin, and have not been adjusted to include only those samples collected in the river basin area.

There was an estimated net gain of 1,493,506 lbs. of phosphorus from animal waste produced in the basin for CY2011 due to an increase of 38,368 animal units (Agricultural Statistics, NCDA&CS, 2012).

Table 6. Relative Changes in Land Use and Management Parameters and their Relative Effect on Phosphorus Loss Risk in the Tar-Pamlico

Parameter	Units	Source	1991 Baseline	CY 2008	CY 2009	CY 2010	CY 2011	91 - 11 Change	CY2011 P Loss Risk +/-
Agricultural land	Acres	FSA	807,026	763,066	756,365	731,408	721,432	-11%	-
Cropland conversion (to grass & trees)	Acres	USDA-NRCS & NCACSP	660	31,110	31,168	31,596	31,631	4,693%	-
CRP / WRP (cumulative)	Acres	USDA-NRCS	19,241	38,375	38,967	41,833	41,833	117%	-
Conservation tillage	Acres	USDA-NRCS & NCACSP	41,415	31,421*	33,905*	35,946	40,612	-1.94%	-
Vegetated buffers (cumulative)	Acres	USDA-NRCS & NCACSP	50,836	214,043	211,360	215,606	227,528	348%	-
Water control structures (cumulative)	Acres Affected	USDA-NRCS & NCACSP	52,984	80,418	81,348	82,844	84,442	59%	-
Scavenger crop	Acres	LAC	13,272	109,741	92,376	108,888	86,283	550%	-
Animal waste P	lbs P/yr	NC Ag Statistics	13,597,734	14,560,934**	14,608,377**	15,202,037	16,695,543	23%	+
Soil test P median	mg/kg	NCDA&CS	83	89	84	86	87	4.82%	+

** Conservation tillage is still being practiced on additional acres but this number only reflects active cost share contract acres, not acres where contracts have expired.*
*** Due to the reporting protocol of the National Agricultural Statistics Service some of the numbers were not available for 2009. The additional numbers were derived from the NCDA & CS Emergency Program and the Division of Water Quality.*

Based on the these findings, the BOC recommends that no additional management actions be required of agricultural operations in the basin at this time to comply with the "no net increase above the 1991 levels" phosphorus goal of the agriculture rule. The BOC will continue to track and report the identified set of qualitative phosphorus indicators to the EMC annually, and to bring any concerns raised by the results of this effort to the EMC's attention as they arise, along with recommendations for any appropriate action. The BOC expects that BMP implementation will continue to increase throughout the basin in future years, and notes that BMPs installed for nitrogen, pathogen and sediment control often provide significant phosphorus benefits as well.

Looking Forward

The Tar-Pamlico BOC will continue to improve rule implementation, relying heavily on the basin technicians to work with the LACs and farmers.

Because cropping shifts are susceptible to various pressures, the BOC is working with LACs in all counties to continue BMP implementation that provides for a lasting reduction in nitrogen loss in the basin while monitoring cropping changes.

The committee overseeing the development of NLEW has been reviewing BMP efficiencies credited by the nutrient accounting software. This review is part of the ongoing examination of practices utilized to assess agriculture's nutrient losses. Any recommended changes from the NLEW committee will be incorporated into nutrient accounting in future crop years.

The BOC will continue to review data from all studies as they are completed and become available and will consider the results as they relate to nutrient loadings from land based sources and uses. This includes studies related to the 2004 NPDES permit issued to Rose Acre Farms.

Basin Oversight Committee recognizes the dynamic nature of agricultural business.

- Changes in the world economies, energy or trade policies.
- Changes in government programs (i.e., commodity support or environmental regulations)
- Weather (i.e., long periods of drought or rain)
- Scientific advances in agronomics (i.e., production of new types of crops or improvements in crop sustainability)
- Plant disease or pest problems (i.e., viruses or foreign pests)
- Urban encroachment (i.e., crop selection shifts as fields become smaller)
- Age of farmer (i.e, as retirement approaches farmers may move from row crops to cattle)

Funding is an integral part in the success of this strategy. Without funding for the technicians, the annual progress reports would fall on the LACs without assistance to compile data and annual reports. In addition, technicians are needed for BMP installation. Farmers and agency staff personnel with other responsibilities serve on the LACs in a voluntary capacity. If funding for technician positions is not available, the LACs would have a difficult time meeting the workload requirements.