Can Conservation Practices Reduce Nutrients?: Case Studies from North Carolina

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Introduction

- Excess nutrients from all sources, including agriculture are impacting drinking water supplies and estuaries in North Carolina.
- Most water resources are impaired by both nitrogen (N) and phosphorus (P).
- Nutrient management regulatory frameworks have been developed in two of the 17 river basins in North Carolina and two drinking resource watersheds.

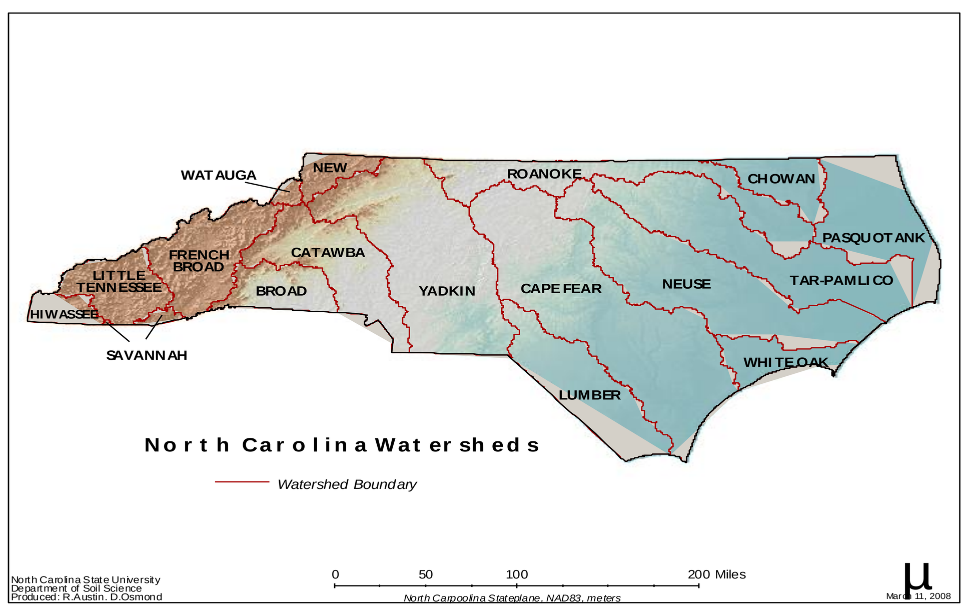

Figure 1. Map of North Carolina River Basins. Regulated basins include the Neuse and Tar-Pamlico as well as drinking water watersheds that are in the upper portion of the Cape Fear and Neuse River basins.

- Agricultural producers expected to reduce N and P; the nutrient reduction objective is based on watershed area.
- Objective of Research: 1) determine nutrient and sediment loads from different agricultural systems and physiographic regions (coastal plain and piedmont) of North Carolina, and 2) determine effectiveness of conservation practices in the piedmont watersheds.

Methods and Materials

- Four watersheds (2 pasture and 2 crop land) were selected in the piedmont and three watersheds in the coastal plain (primarily crop land)

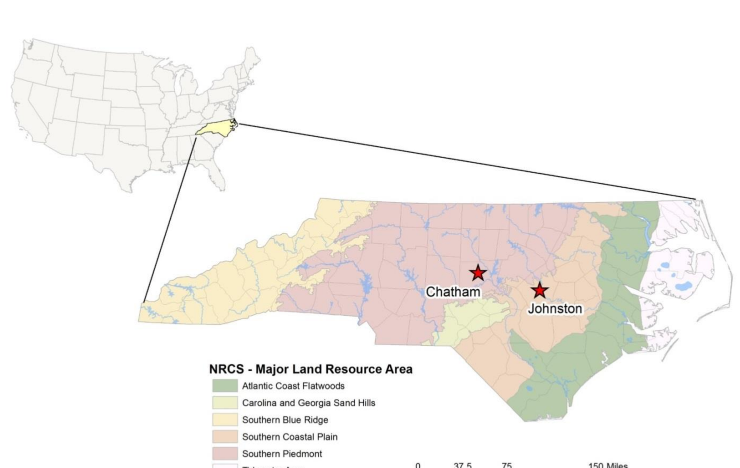

Figure 2. Map of Physiographic Regions of North Carolina. Beige denotes upper coastal plain and pink denotes piedmont.

- Water quality was monitored in the piedmont watersheds for ~4 years, conservation practices were implemented in one pasture and one crop land watershed, and monitoring continued for another 4 years. Water quality has been monitored in the coastal plain watersheds for 3 years.
- Water quality monitoring consisted of:
  - Storm event and monthly grab sampling, continuous rainfall, and discharge
  - Storm: total phosphorus (TP), total Kjeldahl nitrogen (TKN), nitrate- & nitrite-N (NOx-N), ammonium-N (NH_4-N), and total suspended solids (TSS). Total N (TN) calculated by adding TKN and NOx-N
  - Grab: soluble P (PO_4-P), eColi
  - Loads are computed from flow and constituent concentrations
- Land uses are also monitored
- Statistical analysis used ANCOVA to document any changes between watersheds without conservation practices and those with practices (piedmont watershed only) and to quantify the change in nutrient and sediment losses.

Results

Concentration data: coastal plain

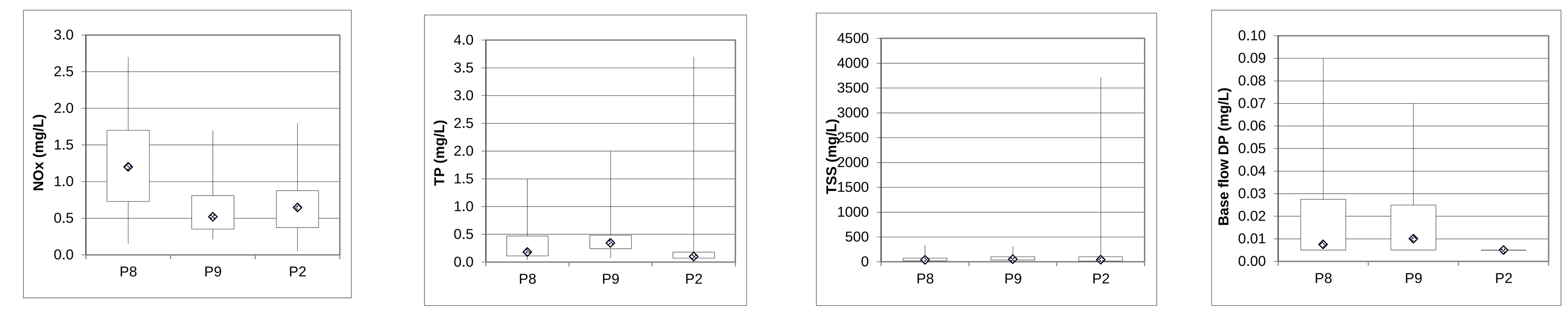

Figure 3. Concentrations of NOx-N, TP, TSS and DP (in grab samples) in three watersheds (P8, P9, and P2): coastal plain North Carolina.

Concentration data: piedmont, pasture only

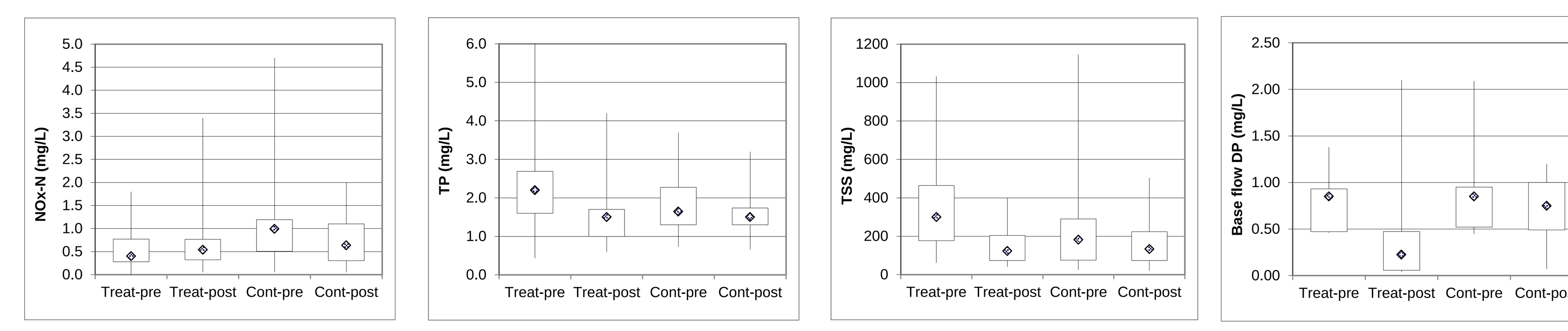

Figure 4. Concentrations of NOx-N, TP, TSS and DP (in grab samples) in two pasture watersheds: Control (Cont) and conservation-impacted (Treat) watersheds and two time periods, before (pre) and after treatment period (post): piedmont, North Carolina.

Load data: coastal plain

Table 1. Load data for TKN, NH4-N, NOx-N, TN, TP, and TSS in three watersheds (P8, P9, and P2): coastal plain North Carolina.

Site	Dur	Rain	Discharge	Run/rf	TKN	NH_4-N	NOx-N	TN	TP	TSS
Coastal Plain	yr	mm	mm				---------------------kg/ha-yr---------------------			
P2	1.19	1266	380	0.30	3.45	0.24	3.03	6.48	0.51	182
P8	1.32	1606	361	0.23	3.62	0.35	3.56	7.18	1.09	123
P9	1.35	1624	473	0.29	6.38	0.40	2.52	8.90	1.43	166

Load data: piedmont,

Table 2. Load data for TKN, NH4-N, NOx-N, TN,TP, and TSS in two watersheds - Control (Cont) and conservation-impacted (Treat) watersheds and two time periods, before (pre) and after treatment period (post); piedmont, North Carolina.

Site	Dur.	Rain[1]	Discharge	Run/	TKN	NH_4-N	NO_x-N	TN	TP	TSS
	yr	mm/yr	mm/yr	rain[2]	---------------------		kg $ha^{-1}yr^{-1}$	-----------------		
Pre-Treatment Implementation Period										
Past-cont	3.77	907	118	0.15	3.31	0.78	1.34	4.65	2.20	273
Past-treat	3.77	907	170	0.22	5.93	1.67	1.15	7.09	3.67	485
Crop-cont	3.44	826	94	0.11	1.08	0.13	2.50	3.57	0.32	288
Crop-treat	3.44	826	67	0.08	0.91	0.14	5.23	6.14	0.21	9.3
Post-Treatment Implementation Period										
Past-cont	3.76	955	196	0.20	5.82	1.14	1.50	7.33	3.23	338
Past-treat	3.76	955	221	0.23	7.11	1.00	1.21	8.31	3.20	305
Crop-cont	2.77	935	145	0.16	3.64	0.43	3.76	7.41	1.01	526
Crop-treat	2.77	935	95	0.10	1.26	0.28	4.95	6.22	0.39	18

Conservation practice effectiveness: piedmont pastures

Table 3. Percent reduction for TKN, NH4-N, NOx-N, TN,TP, and TSS when exclusion fencing and nutrient management are used in pastures: piedmont, North Carolina.

TKN	NH_4-N	TN	TP	TSS
------Percent nutrient and sediment reduction ----				
34	54	33	47	60

Conclusion

- TN loads similar between all watersheds.
- TP loads are much greater from pastures than crop fields irrespective of physiographic region.
- Sediment low in all watersheds.
- Fencing cows out of the stream and nutrient management reduced TN by 33%, TP by 47%, and TSS by 60% in the piedmont watershed.
- Nutrient management reduced P losses (50%) but not TN losses from cropland in the piedmont; N fertilizer application did not change but P application was reduced.

We appreciate funding support for this work from USDA-NIFA #2011-05151, USEPA 319 Pass-through Funds to NC Department of Environmental Quality and USEPA Grant #RD835570