

Environmental and Economic Impacts of Reaching and Doubling the USDA Buffer Initiative Program on Water Quality



**C. Santhi¹, J. D. Atwood², J. Lewis²,
S. R. Potter¹, and R. Srinivasan¹**

**¹ Blackland Research and Extension Center, Texas
A&M, 720 East Blackland Road, Temple, TX 76502**

**² USDA-NRCS, Resource Assessment Division,
Washington D.C.**

Conservation Buffers

- Strips/small land with permanent vegetation
- Trap sediment, nutrients, bacteria and other pathogens
- Help wildlife& fish habitat
- Add recreation and value of farmland



USDA National Conservation Buffer Initiative Program

- **2 Million miles of buffer by 2002**
- **National Buffer Council**
- **Conservation Reserve Program (CRP)**
 - » **Continuous signup provision for buffers**
- **NRCS Technical Assistance**

Progress of the Buffer Initiative Program

**Progress of the Two Million Mile Buffer Program
in June 2001, (Buffer Notes, NACD, 2001)**

Programs	Buffer Miles (Mill.)	Buffer Acres (Mill.)
Continuous CRP and CRP Enhancement programs (CREP)	0.429	1.543
General CRP	0.334	1.202
Wetlands Reserve Program (WRP)	0.018	0.066
Cost Share Programs	0.160	0.575
Technical Assistance Only	0.124	0.445
Total	1.064	3.831

Assessment of Buffer Initiative Program

- **Identify appropriate farmland (likely to be eligible & enrolled) for buffers**
- **Evaluate the economic impacts of converting the farmland to buffers**
- **Estimate the environmental changes due to buffers**

Objectives of the Study

Evaluate the environmental and economic effects of reaching

- **2 million miles of buffer (BUFFER2)**
- **4 million miles of buffer (BUFFER4)**

Integrated Modeling Approach

- **Hydrologic modeling system (HUMUS)**
- **Agricultural economic model (ASM)**
- **Estimate the location and design criteria of buffer acreages**



Hydrologic Unit Model for the United States (HUMUS)

- **Regional scale modeling system developed by USDA-ARS and Blackland Research & Extension Center with financial support from USDA-NRCS**
 - » **Watershed model(Soil & Water Assessment Tool) to predict flow, sediment and nutrients**
 - » **GIS Interface to derive weather and spatial data for 2107 HCUs in US**

- **Buffer simulation through regression equations (Rodriguez et al., 2001) relating trapping efficiencies of sediment and nutrients with strip length and % of cropland buffered**

Regression Equation	Hydrologic group
$R\dot{Y}Q_{AB}=79.37*(1-EXP(-22.38*STL_FLEN))$	A and B
$R\dot{Y}T_{AB}=96.59*(1-EXP(-32.01*STL_FLEN))$	A and B
$R\dot{Y}N_{AB}=95.42*(1-EXP(-21.25*STL_FLEN))$	A and B
$R\dot{Y}P_{AB}=95.65*(1-EXP(-22.19*STL_FLEN))$	A and B
$R\dot{Q}N_{AB}=82.20*(1-EXP(-28.31*STL_FLEN))$	A and B
$R\dot{Q}P_{AB}=83.05*(1-EXP(-21.20*STL_FLEN))$	A and B

R $\dot{Y}Q$ - Reduction in Runoff

R $\dot{Y}T$ - Reduction in Sediment

R $\dot{Y}N$ - Reductions in Organic Nitrogen

R $\dot{Y}P$ - Reductions in Organic Phosphorus

R $\dot{Q}N$ - Reductions in Mineral Nitrogen

R $\dot{Q}P$ - Reductions in Mineral Phosphorus

STL_FLEN - Strip Length-Field Length Ratio

Agricultural Sector Model (ASM)

- **National scale model developed by Texas A&M University and USDA-NRCS**
- **Economic model to simulate market equilibrium effects for resources & commodities**
- **Simulates agricultural production and resources and associated economics for 63 subregions in US**

HUMUS-ASM Applications

- **HUMUS was applied over 2107 HCUs in US to estimate the % of sediment, total nitrogen and total phosphorus trapped by BUFFER2 and BUFFER4 scenarios**
- **ASM was applied over 63 subregions in US to estimate the costs and benefits associated with BUFFER2 and BUFFER4 scenarios**

Buffer Location & Design Criteria for Buffer Scenarios

Scenarios	Buffer Miles (Mill.)	Buffer Acres* (Mill.)	Contributing Area of Buffer (Mill.)
BASELINE**	0.75	2.7***	119.75
BUFFER2	2.00	7.2	160.00
BUFFER4	14.40	14.4	213.15

*** 3.6 acres of buffer/mile of buffer**

**** Based on installation buffers as of Sept. 2000**

***** Owner & cost data available only for 1.2 mill. acres through
CONCRP**

Assumptions in Buffer Scenarios

- 3.6 acres of cropland/mile of buffer
- Buffer width 29.7 ft based on 40 acre field
- Current non-CONCRP buffer acres (1.5 mill. acres) distributed proportional to CONCRP buffer acres across subregions
- Additional acres for BUFFER2 & BUFFER4 are distributed proportional to the gap btw 'ideal' and 'current' across subregions except
 - » Increase at least 20% & 40% in each subregion for BUFFER2 & BUFFER4
 - » Where greater than 100% of cropland buffered is implied in a particular subregion, re-distribute the acres to other subregions with greater gap
- Per-acre cost for buffer for BUFFER2 & BUFFER4 at the same level of current CONCRP provision

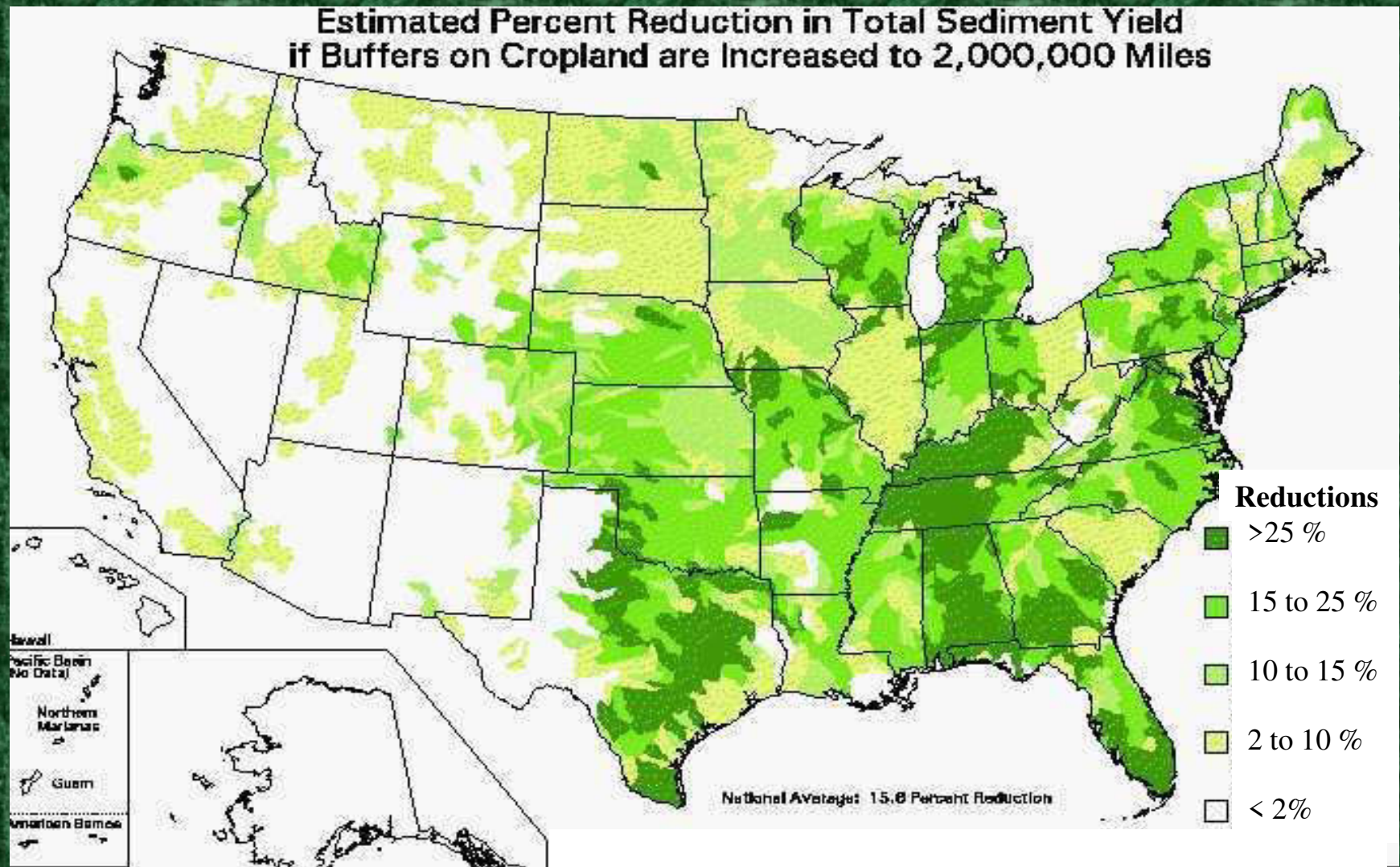
Results

Environmental Impacts

As % reductions in sediment, total nitrogen and total phosphorus

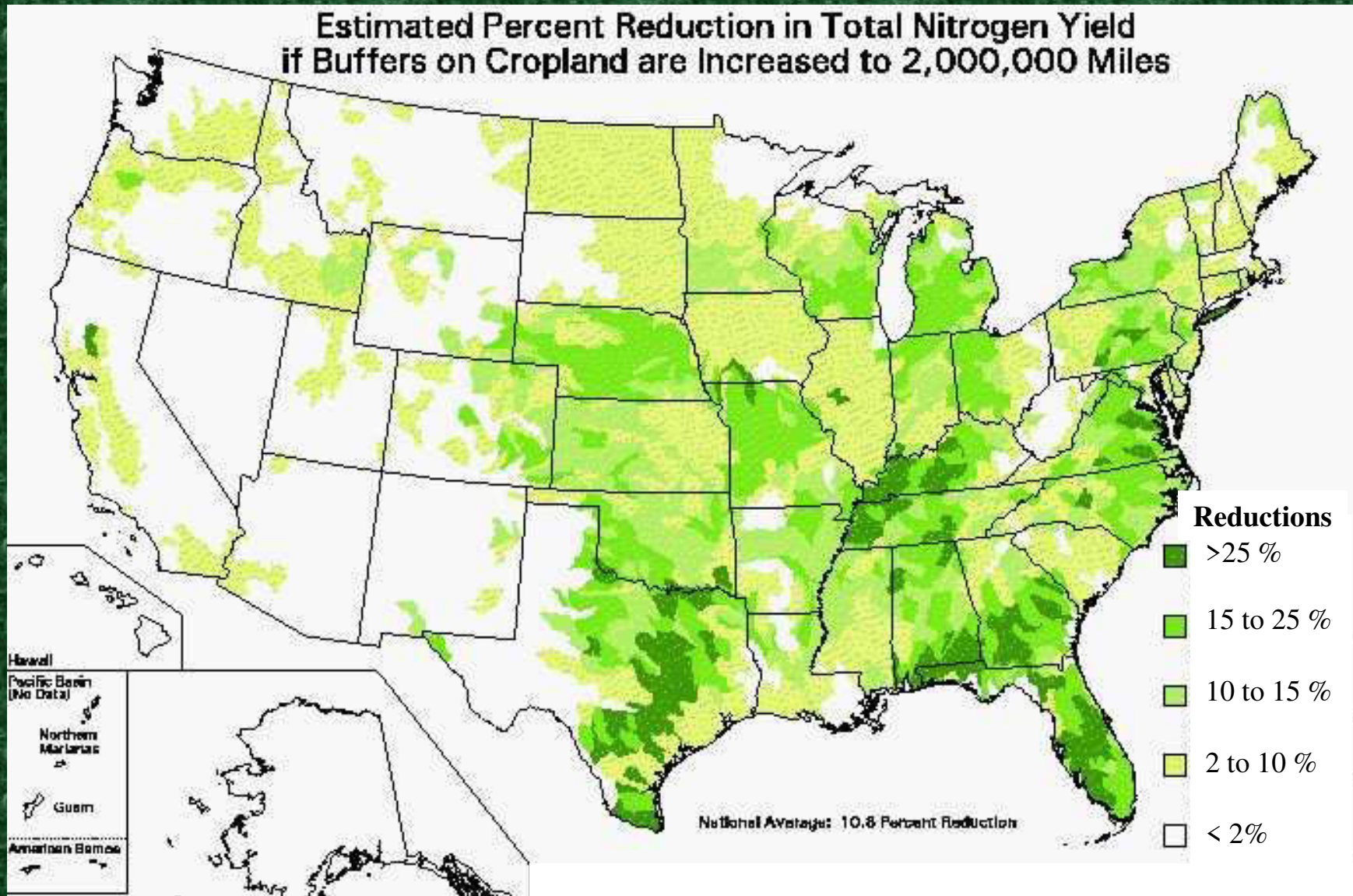
- **Regional level**
- **National level**

Reduction in Sediment for BUFFER2(%)



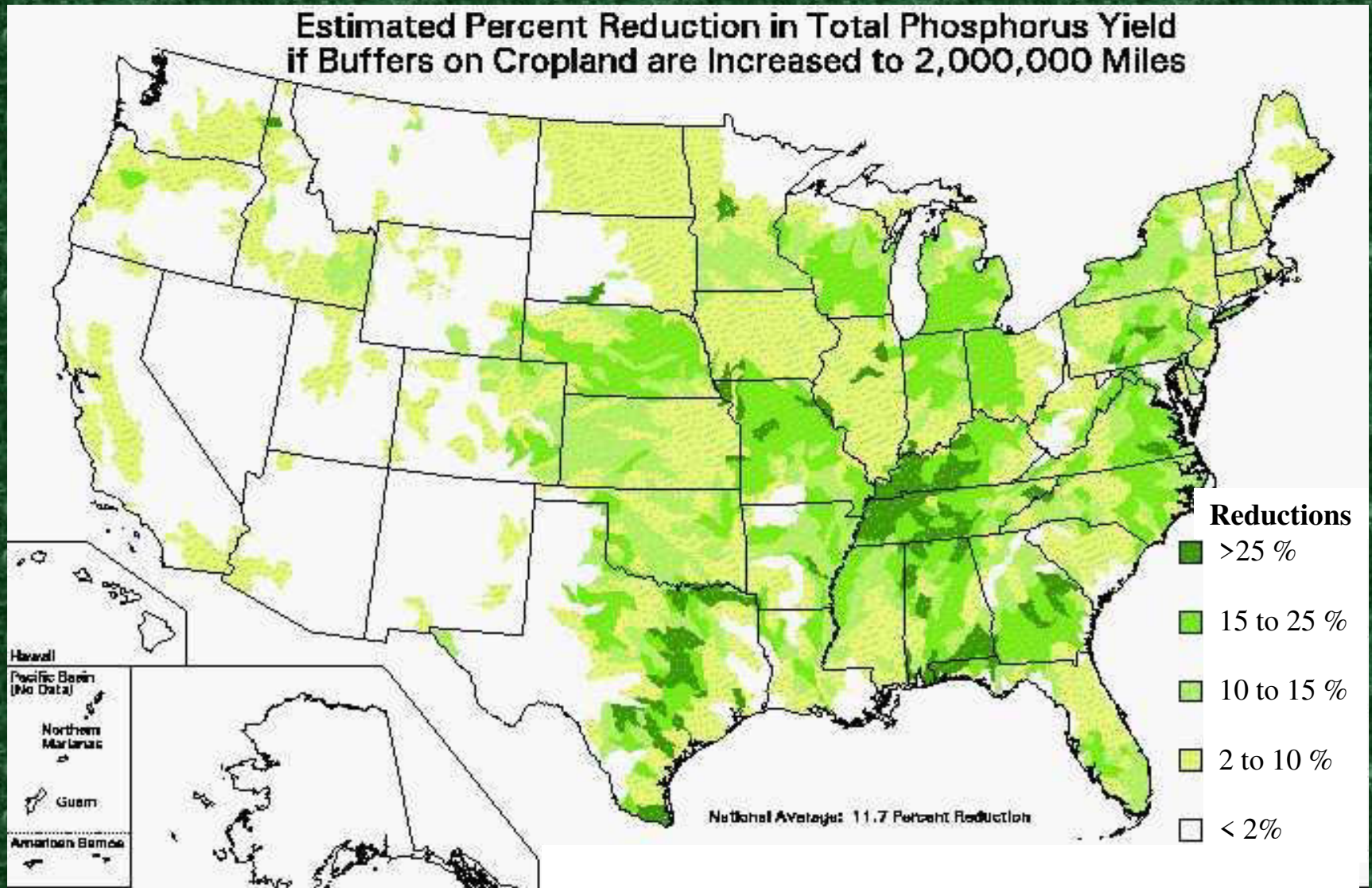
South Dakota: 50.7%(BASELINE), 60.8%(BUFFER2) (%change:20)
Tennessee: 15.1%(BASELINE), 100.0%(BUFFER2) (%change:562)

Reduction in Total Nitrogen for BUFFER2(%)



South Dakota: 50.7%(BASELINE), 60.8%(BUFFER2) (%change:20)
Tennessee: 15.1%(BASELINE), 100.0%(BUFFER2) (%change:562)

Reduction in Total Phosphorus for BUFFER2(%)



South Dakota: 50.7%(BASELINE), 60.8%(BUFFER2) (%change:20)
Tennessee: 15.1%(BASELINE), 100.0%(BUFFER2) (%change:562)

National Estimates

National Estimated Reductions in Sediment and Nutrients for the Buffer Scenarios#

Parameters	BUFFER2 (%)	BUFFER4 (%)
Sediment	15.6	28.9
Total Nitrogen Field Losses	10.8	27.2
Total Phosphorus Field Losses	11.7	25.3

Estimates based on area weighted average for cropland and non-cropland

Economic Impacts

- **Reduced commodity production; Food inelastic demand; Price increases for producers; Producer's benefit more than cost**
- **Cost increases for consumers due to reduced production**

Estimated Economic Changes for the Buffer Scenarios

Parameters	BUFFER2 (%)	BUFFER4 (%)
Producer Income (+)	0.8	2.8
Crop Area (-)	1.0	2.6
Per-acre Cost of Production (+)	1.1 (\$ 1.8)	2.8 (\$ 4.6)
Crop Profit due to Price Increase (+)	4.0	11.3

Annual Economic Impacts

Parameters	BUFFER2 (Mill. \$)	BUFFER4 (Mill. \$)
a)U.S. Consumers Losses from Reduced Supply	673	1449
b)Program Payments to Landowners	524	1338
c)Federal Technical Assistance Cost	125	312
d)U.S. Producers Net Gain from Higher Prices	529	1847
e)Total Net Cost (a+b+c-d)*	793	1302
f)Value of Water Quality Improvements	3288	5650
g)Benefit Cost Ratio (f/e)	4.1	4.3

*Market impacts in rest of world (trading partners)
not shown here

**Based on the per-ton and per-acre studies of
erosion reduction programs

Conclusions

- **Water quality and economic analyses showed buffer programs to be cost effective**
- **More research needed to enhance landowners participation in the buffer programs**

United States Dept. of Agriculture-National Resources
Conservation Service (www.nhq.nrcs.usda.gov)
Blackland Research&Extension Center (www.brc.tamus.edu)

Thank You

