Low-Grade Weirs: Agricultural Best Management Practice for nitrate-N Mitigation

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The Nature Conservancy-MS Chapter
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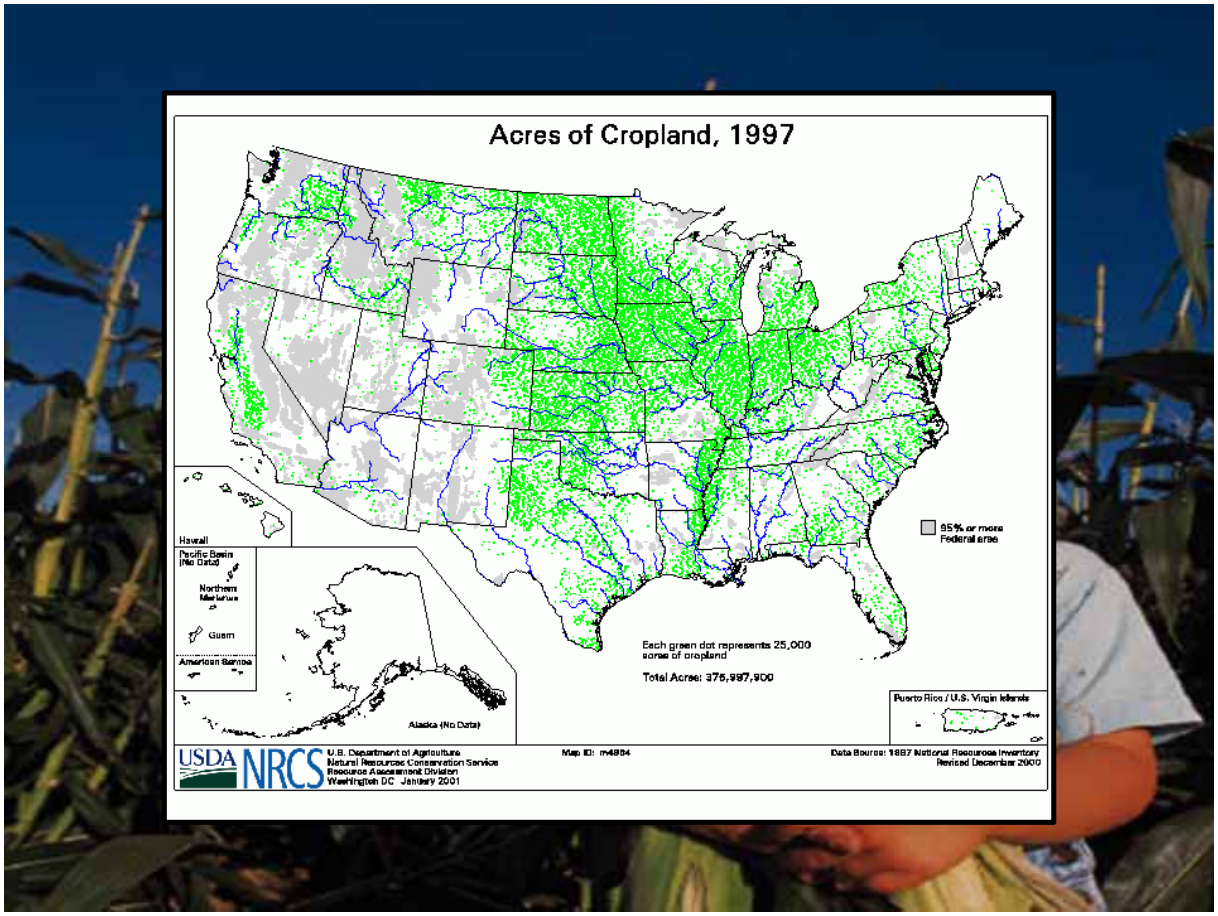
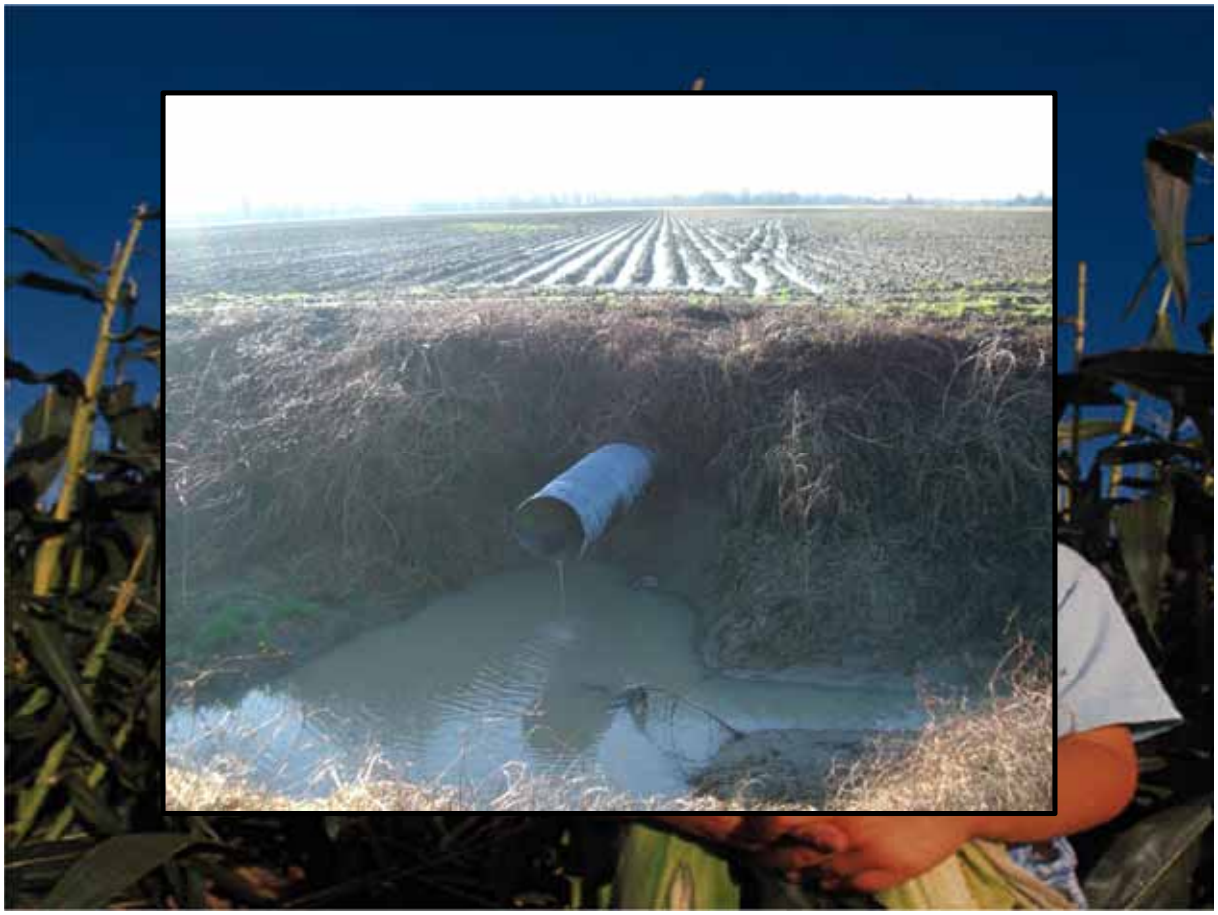

Acres of Cropland, 1997
Hawaii
Pacific Basin (No Data)
Northern Marianas
Guam
American Samoa
Alaska (No Data)
Puerto Rico / U.S. Virgin Islands
85% or more Federal area
Each green dot represents 25,000 acres of cropland
Total Acres: 375,997,900
USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service
Resource Assessment Division
Washington DC January 2001
Map ID: nri98d
Data Source: 1997 National Resources Inventory
Revised December 2000



Controlled Drainage

- Reduce Flow Velocity
- Sediment Retention

Vegetated Drainage Ditches

- **Mini Wetlands**

– Reduced Flow Velocity

– Nutrient Cycling

Low Grade Weir

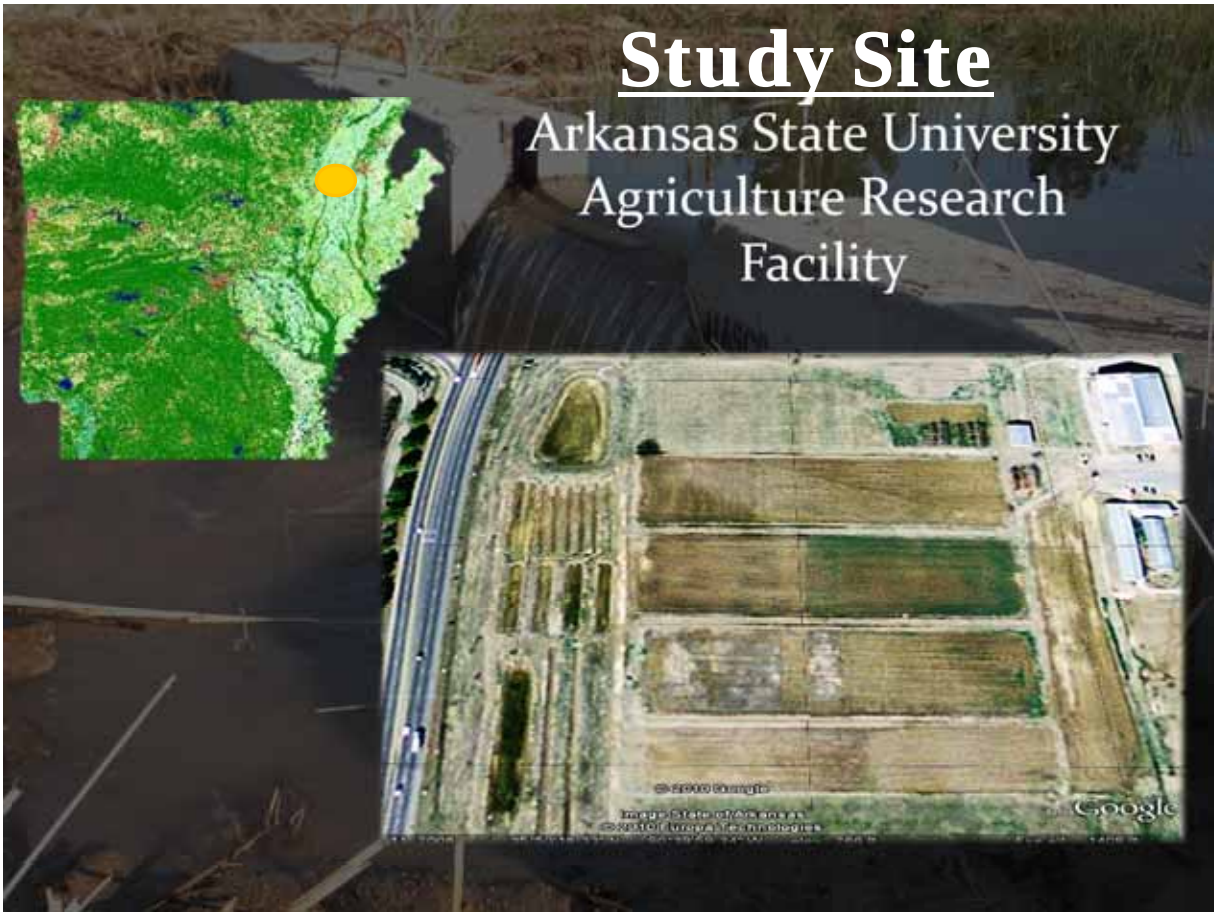
- **Innovative**
- **Inexpensive**

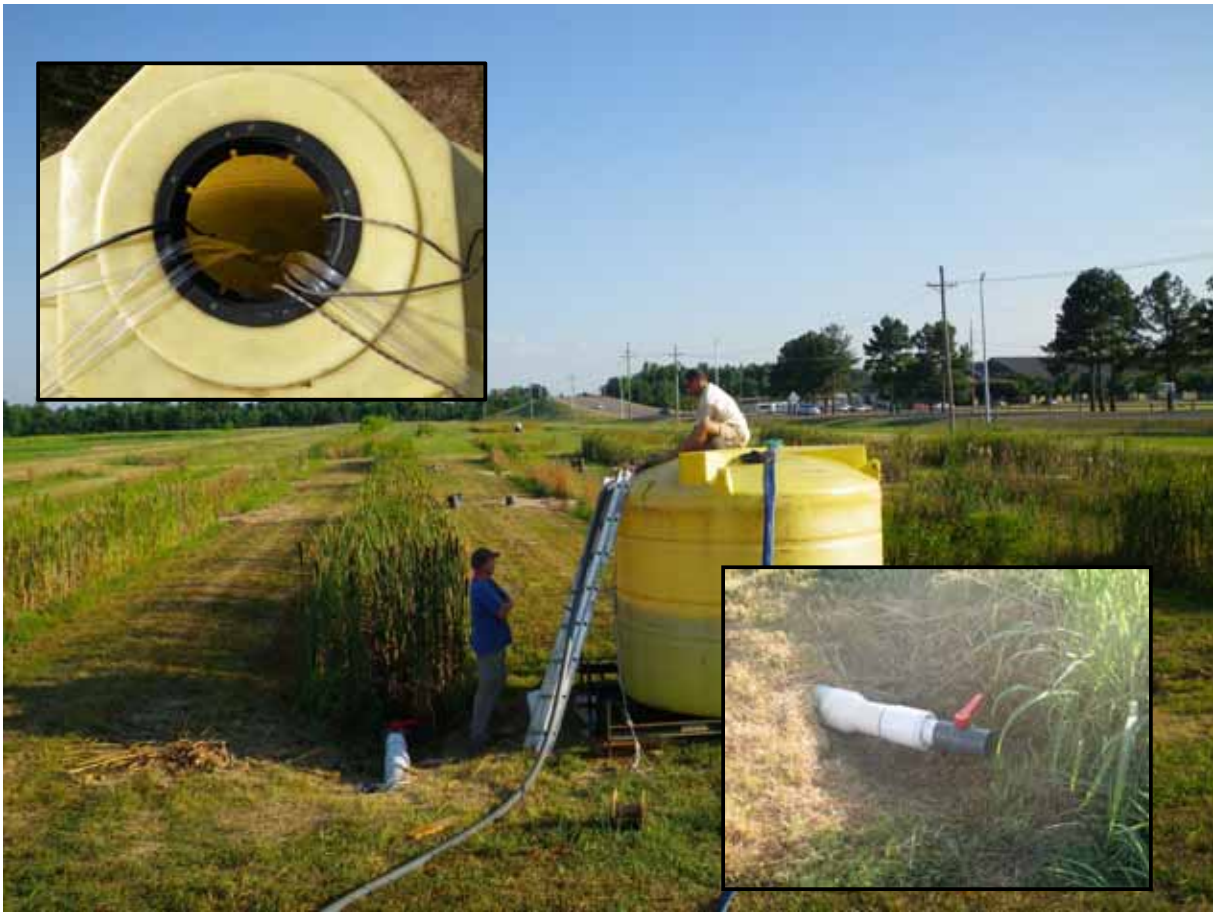
Objectives

Assess the nutrient (nitrate-N) reduction efficiencies of a multiple weir system

Study Site

Arkansas State University
Agriculture Research
Facility



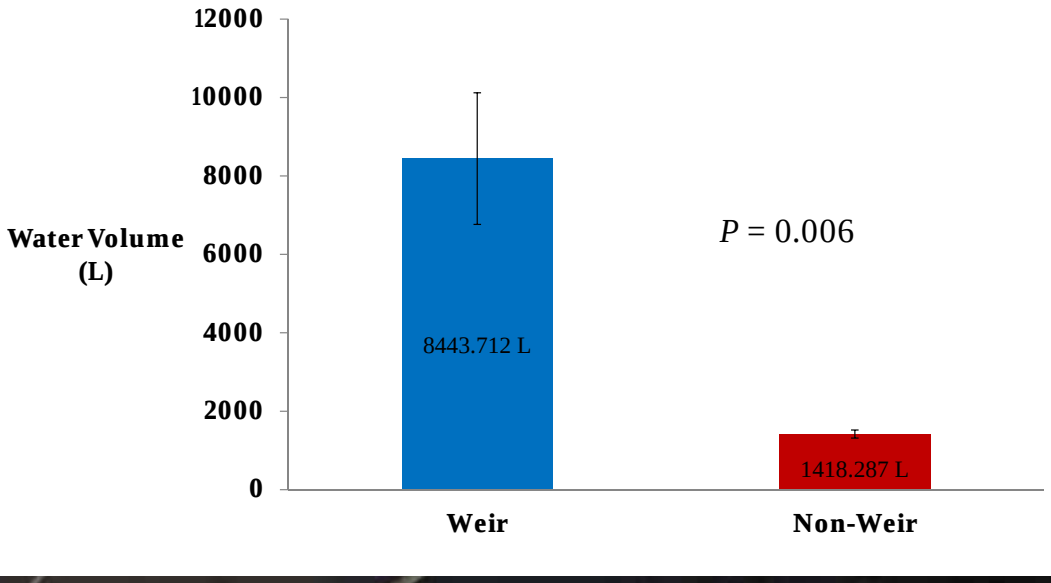


Water samples

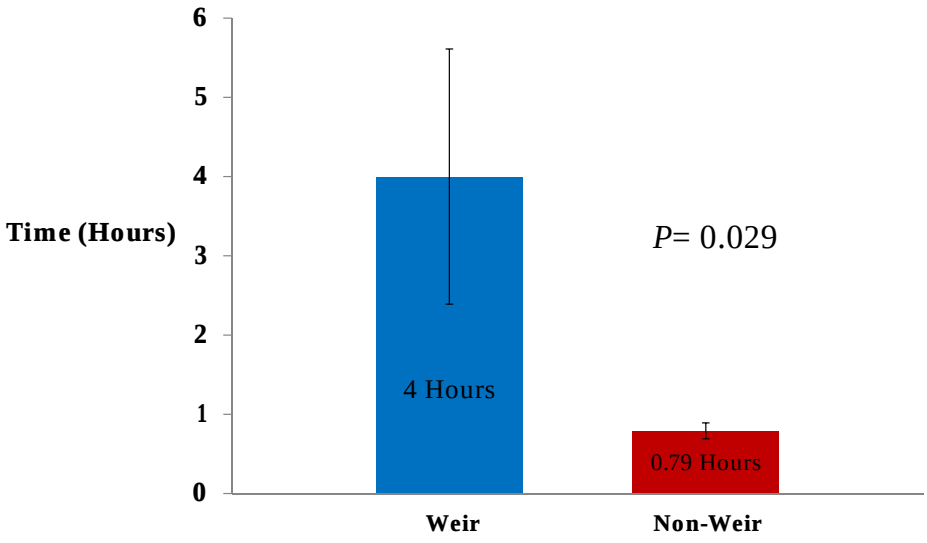
- Stored at 4°C & transported to Mississippi State University Water Quality Laboratory

- Nitrate Analysis
  - Flow Injection Analysis – Quikchem 8500 Lachat
  - Cadmium reduction method ($NO_x - NO_2 = NO_3$)

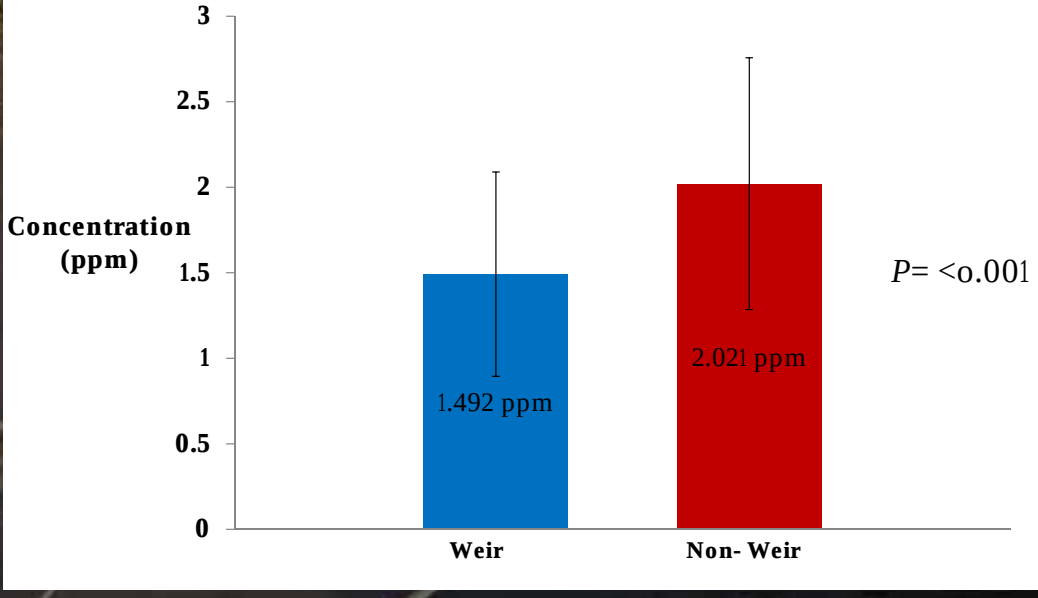
Mean Water Volumes



Mean Hydraulic Residence Time

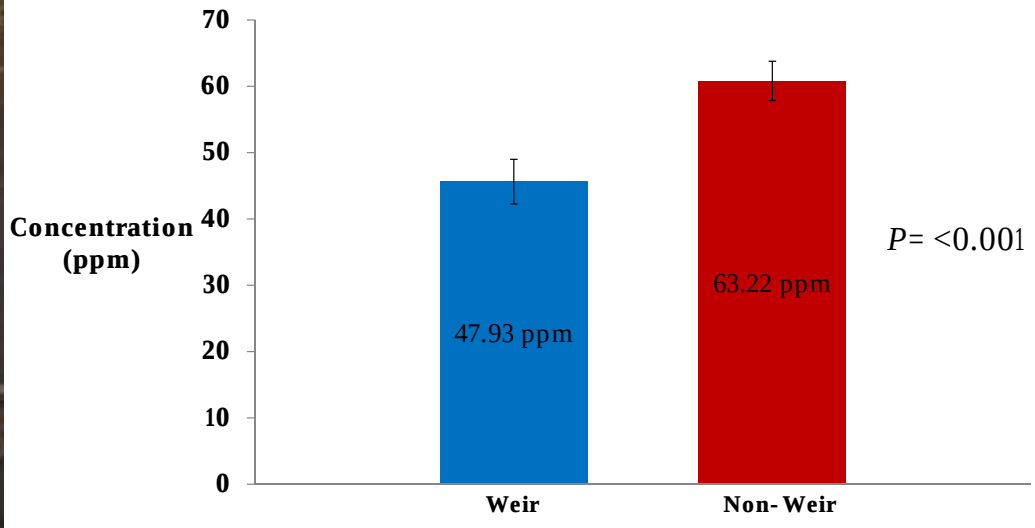


Mean NO_3^- Outflow Concentration



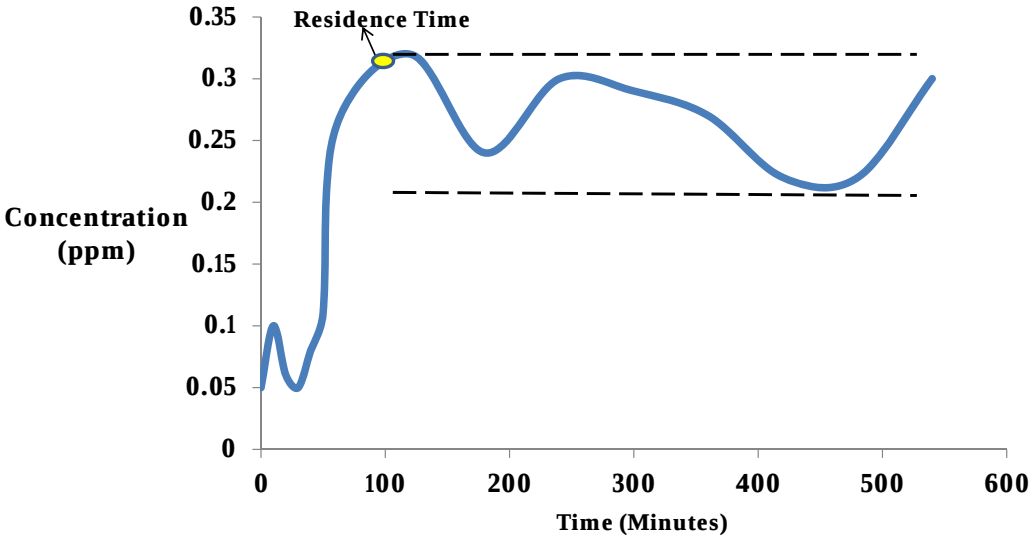
P= <o.001

Mean NO_3^- Outflow Load

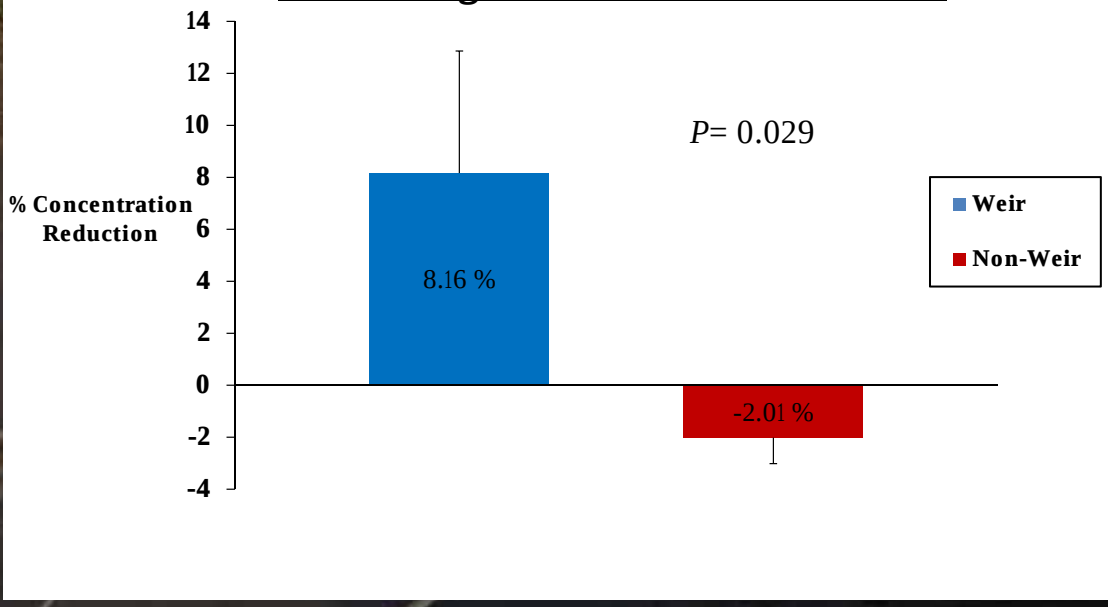


P= <0.001

Biogeochemical Effect



Mean Biogeochemical % Reduction



Study Site

-Wolf/Broad Lake Watershed

- Yazoo River Basin

- 2 Weir System
- Terraced Slope
- 2 Years Old

- Length= 500 m
- Channel Bed= 4000 m^2
  - 33% of channel bed impacted by weirs
- Drainage Basin = 940 hectares

Objectives

Assess the nutrient (nitrate-N) reduction efficiencies of:

-Individual weirs

-Multiple weir system

Water samples

- **Collected from September 2009–February 2011**

- **Base Flow Samples**
  - **Growing Season (Mar.- Oct.)= Every 3 weeks**
  - **Dormant Season (Nov.- Feb)= Every 6Weeks**
  - **Cubitainers**

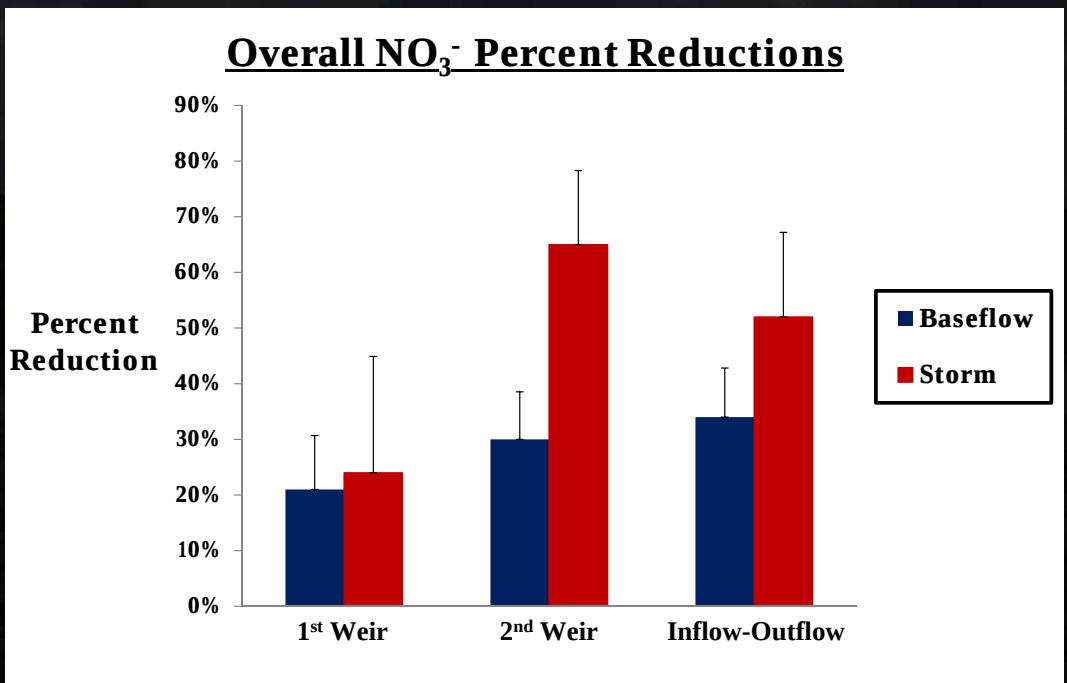
- **Storm Samples**
  - **Within 24-48 hours after storm event**
  - **Permanent staked samplers**

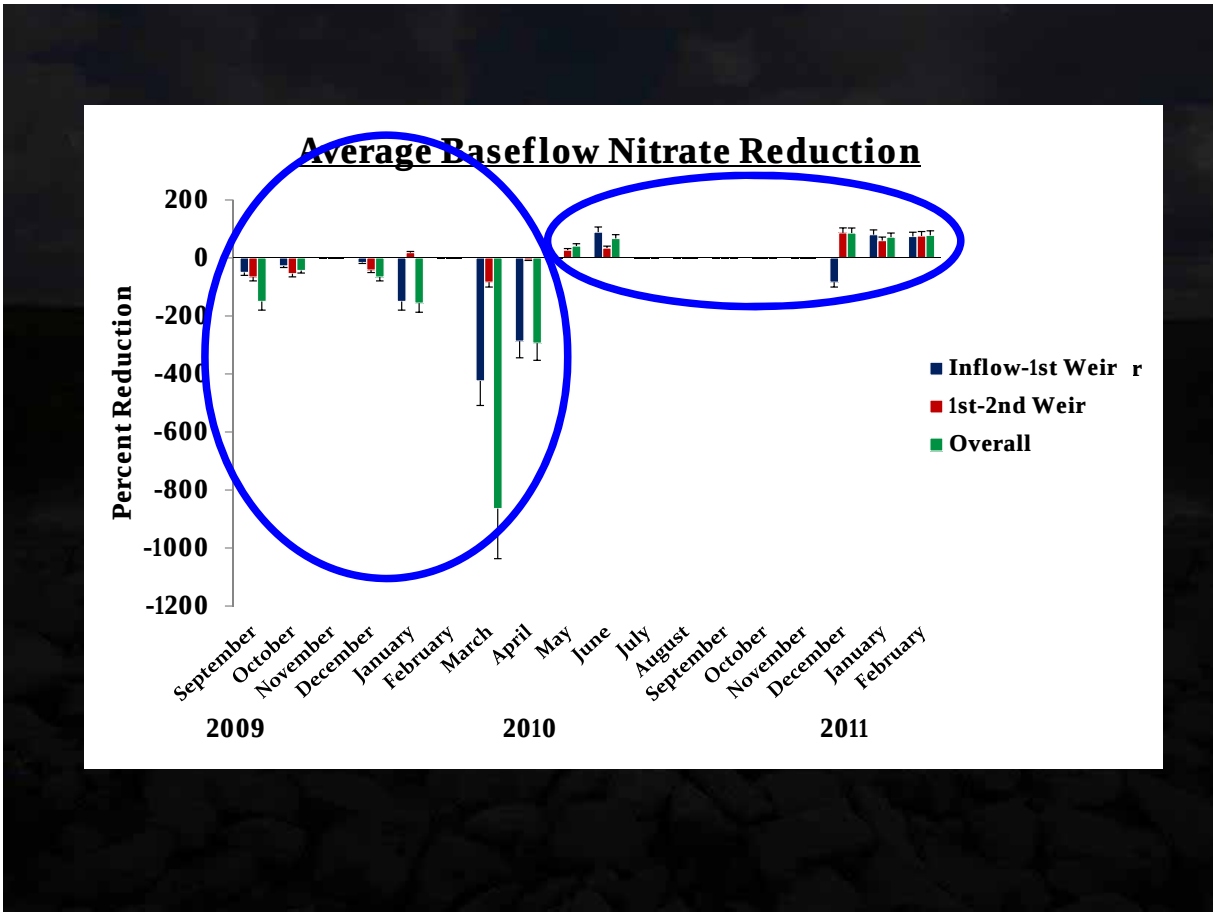
Water samples

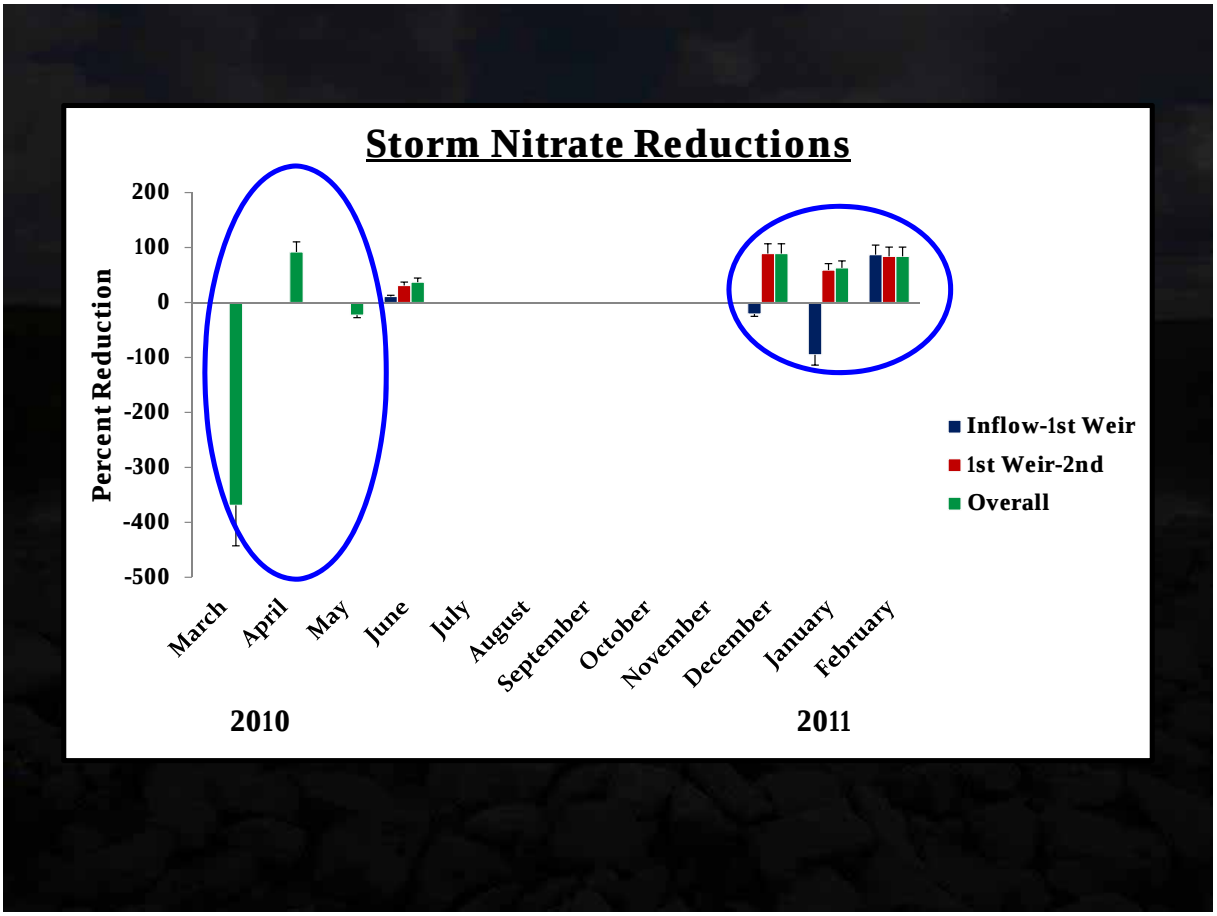
- Stored at 4°C & transported to Mississippi State University Water Quality Laboratory

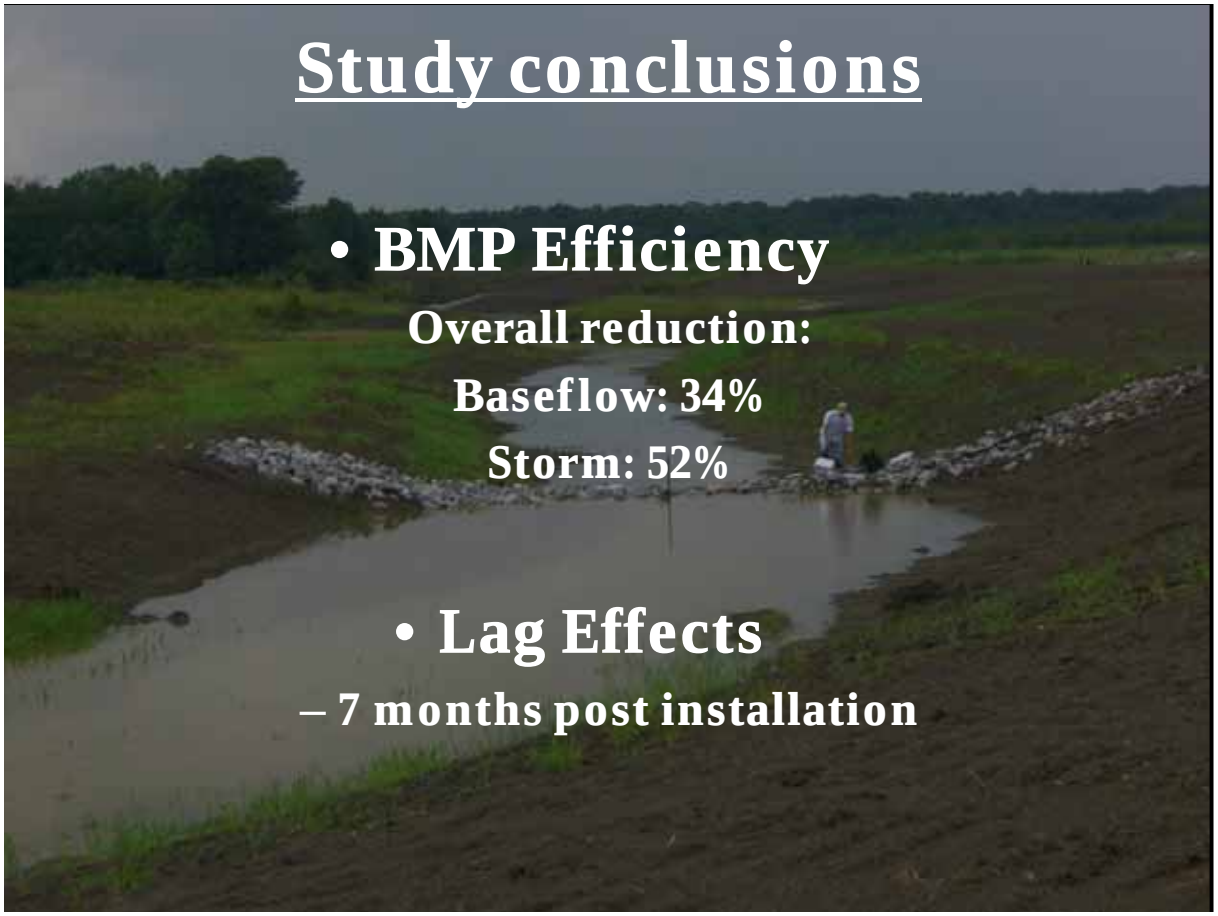
- Nitrate Analysis
  - Flow Injection Analysis – Quikchem 8500 Lachat
  - Cadmium reduction method ($NO_x - NO_2 = NO_3$)

Overall NO_3^- Percent Reductions




Average Baseflow Nitrate Reduction
Percent Reduction
200
0
-200
-400
-600
-800
-1000
-1200
September
October
November
December
January
February
March
April
May
June
July
August
September
October
November
December
January
February
2009
2010
2011
Inflow-1st Weir r
1st-2nd Weir
Overall


Storm Nitrate Reductions
Percent Reduction
200
100
0
-100
-200
-300
-400
-500
March
April
May
June
July
August
September
October
November
December
January
February
2010
2011
Inflow-1st Weir
1st Weir-2nd
Overall



Study conclusions

- **BMP Efficiency**
  - Overall reduction:
  - Baseflow: 34%
  - Storm: 52%
- **Lag Effects**
  - – 7 months post installation

Management Implications

- **Valuable Tool**
  - – Common Landscape Feature
  - – Nutrient Cycling Enhancement
  - – Wetland Services

Acknowledgements

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DELTA F.A.R.M.