Mississippi Nutrient Reduction Strategies

A COLLABORATIVE EFFORT BETWEEN STATE AND FEDERAL AGENCIES TOWARD HOLISTIC ECOSYSTEM IMPROVEMENT FOR MISSISSIPPI, MISSISSIPPI RIVER BASIN AND THE GULF OF MEXICO

Collaboration (Within State)

Spatial Scale of Involvement

Farmers

Farmer to Farmer Exchange

State agencies collaboration

Consensus Driven Outputs

www.deq.state.ms
Mississippi’s Approach: Collaborative Foundation

Gulf Coast Ecosystem Restoration Task Force (GCERTF)

Gulf of Mexico Alliance // Hypoxia Task Force // Mississippi River Basin

**MRB States**
- Mississippi

**MRBI**
- ACT

**MRB Scale**
- Coastal Water Quality
  - Education/Outreach
    - Public listening sessions
    - Interstate collaboration
    - Gulfside problem solving
  - Nutrients
    - Governors Action Plan and Hypoxia Task Force / Gulf of Mexico Alliance for nutrient reduction
    - Action Item #4: Nutrients
      - Action Steps #4.3: Partnerships, BMPs for nutrient reductions, invest in new technologies
      - Task #4.3.1: Develop, implement, evaluate innovative nutrient management strategies
    - Region specific nutrient Reduction Strategy e.g., MS Delta Nutrient Reduction Strategy
  - <45% of TN and TP for Hypoxia reduction
  - <2000 ac
    - Edge of Field Water Quality
      - Strategies for landscape enhancement
      - Nutrient Management
      - Innovative Practices
      - NGOs Stakeholder + Research
    - Sub watershed
      - MBRI Priority
      - Landowner Co-op
      - Implementation
    - Innovative nutrient reduction Strategies
      - Act: Avoid/Control/Trap Nutrients

**Coastal Water Quality**
- <2000 ac
- Water Quality
- Nutrients
- Innovative nutrient reduction strategies
- 50-80% N reductions translated to GOMA and GCERTF

**Education/Outreach**
- Feedback loop better WQ, better education, more techniques, better WQ

**Nutrients**
- 12 MRB States
  - KY/TN/VA/NC/SC/MS/MO/IL/TN/WI/AR

**Mississippi River Healthy Basin Initiative**
- MS
  - 6 Priority Watersheds
  - HUC 8 Priority e.g., Big Sunflower 2003-2020
  - <2000 ac
    - Implemented & Monitored sub-watershed
Keys to Nutrient Reductions

- Water Management
  - Water Conservation
  - Alternative Water Supplies
- BMPs
  - Effectiveness for nutrient concentration/load reductions
  - Creating scaled management of BMPs
- Leverage resources and outputs to address both water quality & quantity and highlight/showcase our successes!

Harris Bayou 319  $800k+$533k private

- Pilot Watershed
  - Nutrient Reduction Strategy
- Two Questions???
  - What is attainable?
  - What is the cost?
- Focus efforts - Achieve results
  - 1,800 acre watershed
  - On-Farm storage reservoir
  - Tail-Water recovery system
  - Low grade weirs
  - Two-stage ditches
  - Pads/pipes
  - Grass waterways
Porter Bayou 319 $800k + $533k private

- Pilot Watershed
  - Nutrient Reduction Strategy
- Two focus areas
  - “North Site”
    - Rice/bean
    - On-farm storage reservoir
    - Tail-water recovery systems
    - Pads/Pipes
  - “South Site”
    - Corn/cotton
    - Two-stage ditches
    - Low grade weirs
    - Water control structures
    - Grass waterways

Project began in 2008
- 220+ BMPs installed
  - 11 landowners
  - 11,000 + acres
- MSU monitored efforts
  - Too early for “in-lake” results
  - Other factors “wind”
  - BMPs performing well

Wolf Lake 319 $1,250,000

- Project began in 2008
- 220+ BMPs installed
  - 11 landowners
  - 11,000 + acres
- MSU monitored efforts
  - Too early for “in-lake” results
  - Other factors “wind”
  - BMPs performing well
Partnership with Mississippi State University
- $190K to Delta F.A.R.M. for implementation
- $494K to MSU for monitoring
- Primary purpose to evaluate BMPs
  - Low grade weirs
  - Water control structures
  - Two-stage ditches
  - Grass waterways
- Focus efforts in 7 sub-watersheds
  - 6 in Tchula Lake
  - 1 in Wolf Lake

Mississippi: Solution(s)

Three strategies for reducing nutrient/fertilizer pollution:
WATER CONTROL STRUCTURES: OFF CHANNEL NUTRIENT ASSIMILATION

- Hard to quantify
- Reduce Flow Velocity
- Sediment Retention
- First contact - Edge-of-field

Unknown Inputs

Sediment Accumulation

- TB1
- TB2
- TB3
- CSP

Time (days)

Sediment Accumulation (mm)
\[ y = -0.0011x^2 + 0.9286x \]
\[ R^2 = 0.7419 \]

- Sediment accumulation amounts between replicates significantly different
- Significant difference in slope between
  - \(0-235\) (0.81-0.99) and \(235-634\) (0.01-0.3)

Sediment accumulation rates (0-634 days)
- \(-0.05 \pm 0.62\) mm/day
- \(0.035 \pm 1.101\) mm/day
- \(0.34 \pm 0.50\) mm/day
- \(0.48 \pm 0.36\) mm/day

Median \(T_{0-235} = 1.550\) mm/day (0.328 – 2.2 ~25-75%)
Median \(T_{235-634} = -0.0357\) mm/day (-0.59-0.455)
Vegetated Drainage Ditches

Mini Wetlands
- Reduced Flow
- Nutrient Cycling
VADD ~ 30-45% for N and P reduction

Use of vegetated drainage ditches as tools to reduce nutrients

Modify water residence w/ the use of low weirs in the drainage ditch

Low-Grade Weirs

Increase water residence time =

More contact time for contaminants (e.g. nutrients, pesticides, etc.)

Delicate balance between water movement in ditch and contaminant processing time...after all, it’s still a ditch!
**Scurlock Weirs**

Innovative - modular
Inexpensive:
14 x 4ft weir = $1670

Larger Systems:
Earthen berm w/ rip-rap
$800 / ton ~ $1600 - $2000 / weir
**LOW-GRADE WEIRS: AFFECT RESIDENCE**

Hydrology was affected by weirs and vegetation

Low grade weirs with vegetation or without vegetation increase hydraulic residence time

As shown earlier - w/vegetation could improve nutrient reduction

How is hydrology impacted in the field????
Repeated Measures ANOVA

No-Weir = 0.205 mg/L  
Weir = 0.156 mg/L

T = 420mins

No difference in concentrations
gradual attenuation with
the removal of dilution

Sediment Accumulation behind Weirs

BEE LAKE

WOLF LAKE
Management Implications

Putting it all together:

When to dredge?

<table>
<thead>
<tr>
<th>Time</th>
<th>Sediment</th>
<th>Phosphorus</th>
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When to dredge?

- Length = 500 m
- Channel Bed = 4000 m^2
  - 33% of channel bed impacted by weirs
- Drainage Basin = 2050ac
- Results have documented 9 month lag effect
How do we truly document these successes? Need an on the ground delivery vehicle …
The REACH program goal is to create a network of cooperative farms in Mississippi, with variable agricultural systems, conservation initiatives and ecosystem monitoring to illustrate the success of conservation practice implementation on landscape stewardship.