Modeling Sediment and Nutrient Loads Input to Texas Gulf and Effects of Agricultural Conservation Practices on Water Quality

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Conservation Effects Assessment Project (CEAP) - National Assessment

Conservation programs/practices installed in the US since 1960's and earlier; To increase agricultural production, control soil erosion and nutrient losses and sustain the environment.

CEAP – Cropland National Assessment : Goal

- To measure the environmental benefits of currently existing conservation programs <u>on cropland</u> at regional/national level, and

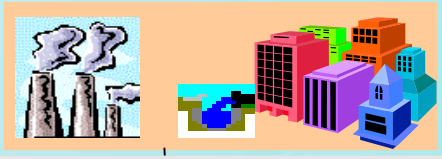
- To assess the potential gains of environmental benefits with additional conservation treatment needs and develop new programs more effectively and efficiently

CEAP/SWAT/APEX National Modeling System

Watershed Configuration Details (Subbasins/Rivers/Routing/Reservoirs)

Weather (Precipitation, Temperature and others)

Dry and Wet Atmospheric Nitrogen Deposition



SWAT Watershed Model (Calibrated)

APEX Farm Scale Model (Calibrated)

Point Sources: Flow, TSS and nutrient loadings from Municipal and Industrial Plants

Uncultivated Land: Flow, sediment, nutrient and pesticide loadings from HRUs

Cultivated Cropland &CRP: Edge of field flow, sediment, nutrient & pesticide loadings from subareas with practices

Effects on Edge of Field Water Quality

INTEGRATE APEX OUTPUT

Instream Processes: Routing through reach, ponds, reservoirs to 8-digit watershed outlet & through main river reaches to basin outlet

SCENARIOS

1. Current Conservation Baseline: SWAT simulation using APEX output with current conservation practices
2. No Practice: SWAT simulation using APEX output without conservation practices
3. Additional Treatment Need: SWAT simulation using APEX output with ENMC and ENMA
4. Background: SWAT simulation with APEX output with background grass-tree mix condition

Conservation Scenarios

1. Current Conservation Baseline: APEX inputs with current conservation practices from CEAP survey
2. No Practice: APEX inputs without conservation practices
3. Additional Treatment Need: APEX inputs with different combinations of practices & practice acres (ENMC and ENMA)
4. Background: APEX inputs with grass-tree mix condition on cropland

RESULTS

Effects on Local/Instream Waters

1. Reductions in sediment, nutrients and pesticide yields and loads at 8-digit watersheds due to current conservation practices and additional treatment practices on cropland
2. Reductions in instream loads at river points due to current conservation and additional treatment scenarios

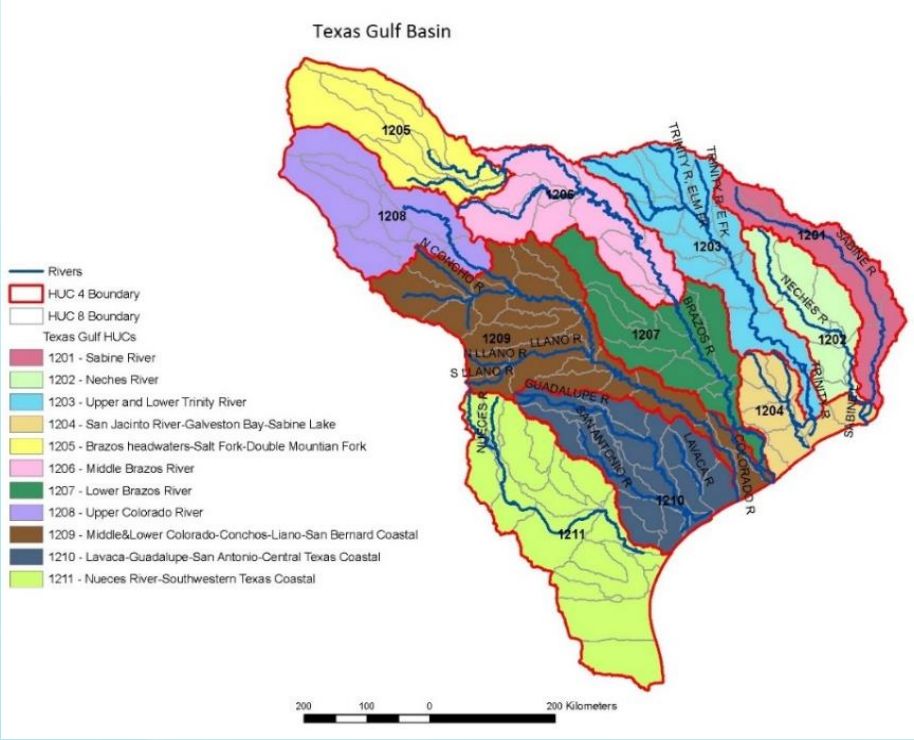
NRI/Survey/Conservation Practice Details

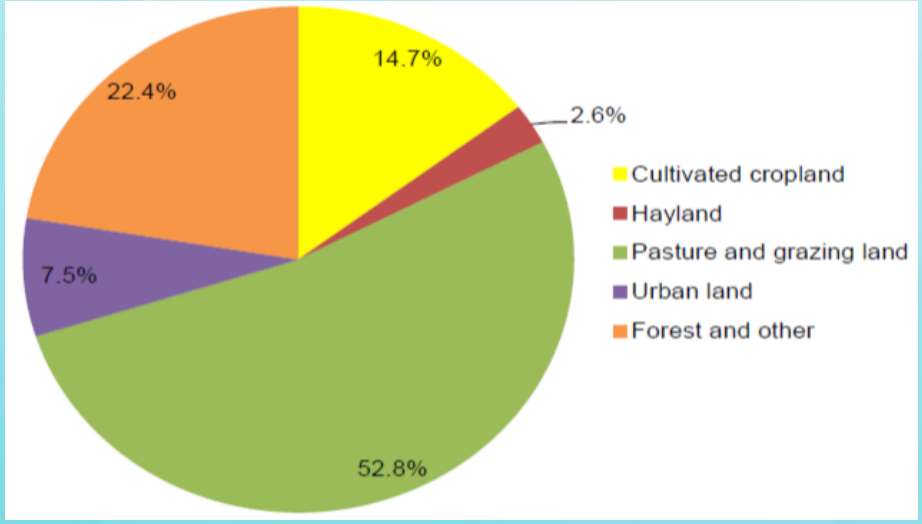
- Structural Practices
- Cultural Management Practices
- Practice Acres
- Farming Activities/Survey Database
- NRI

Presentation Overview

- Texas Gulf Basin – Calibration and Validation
- Determine the Sediment and Nutrient Loads input to the Texas Gulf
- Determine the Major Sources of Sediment and Nutrients in the Texas Gulf Basin
- Determine the Off-site Benefits of Agricultural Conservation Practice Scenarios on Water Quality in the Texas Gulf Basin

Texas Gulf Basin





Drainage Area: 4,70,805 km^2

Population: Approx. 30 Million

10% - U.S. Farmland

40% - Nation's Upland Cotton

29% - Nation's Grain Sorghum

Livestock operations

Industries around the coast and major cities

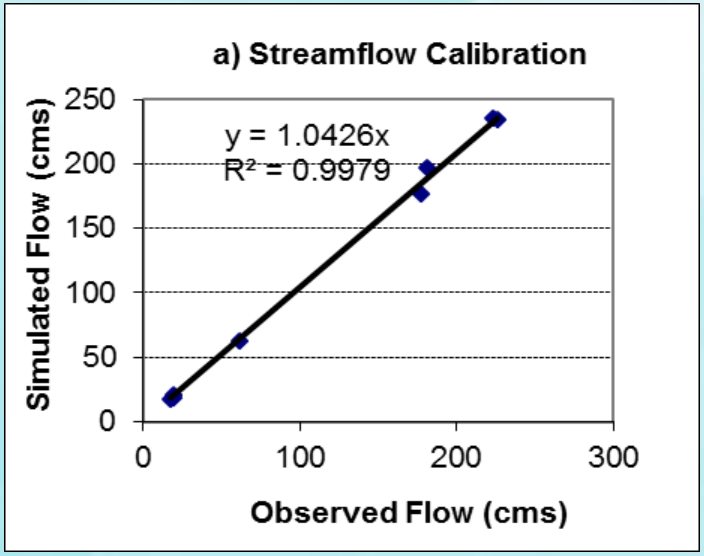
Dominant source of sediment and nutrients to the Coast/Bay Areas

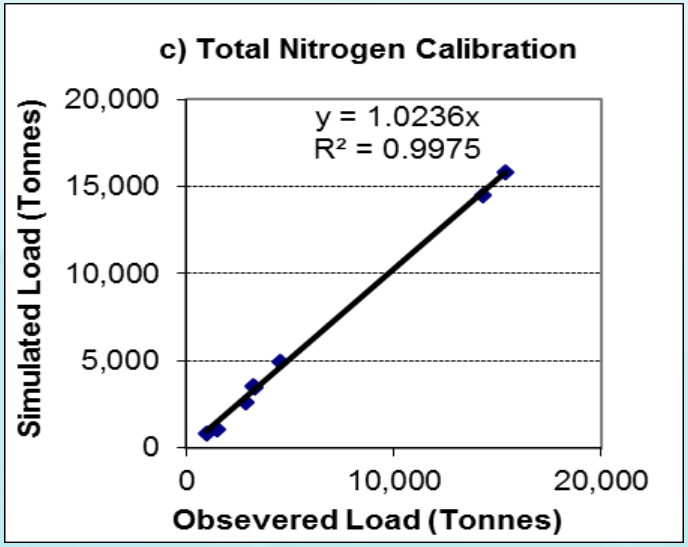
Eutrophication–Low DO-Fish Kill

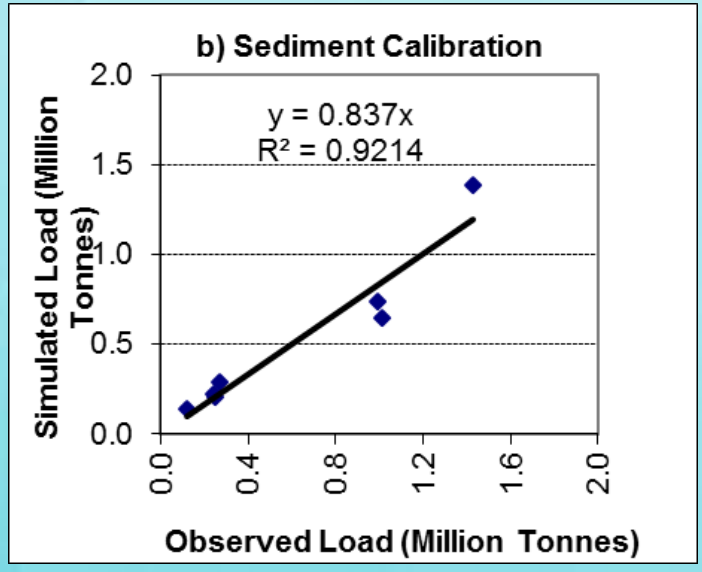
Calibration Gages

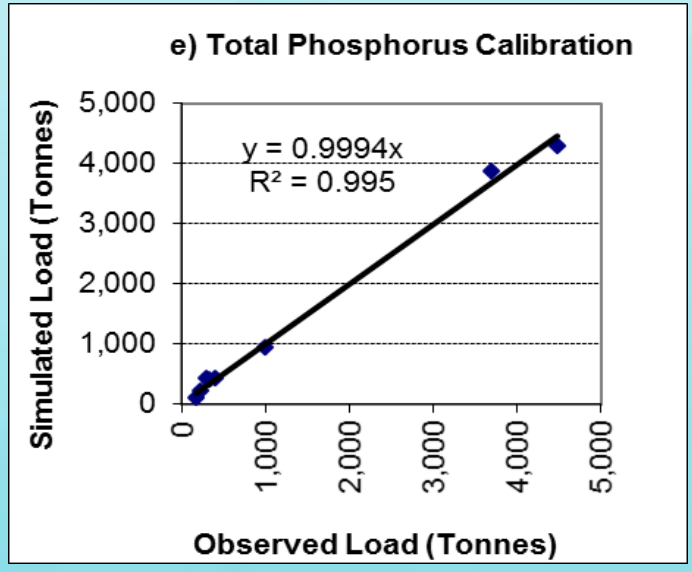
Gauging Station Name	Gage ID on Map	Hydrologic Unit Code	Drainage Area (km^2)
Calibration Gages			
Trinity River near Crockett	S1	12030201	36,016
Neches River near Evadale	S2	12020003	20,585
Nueces River near Three Rivers	S3	12110111	39,941
Sabine River near Ruliff	S4	12010005	24,153
San Antonio near Falls City	S5	12100301	5,471
Brazos River near Rosharon	S6	12070104	117,383
Colorado River near San Saba	S7	12090106	80,821
Guadalupe River near Victoria	S8	12100202	13,458

Calibration Results





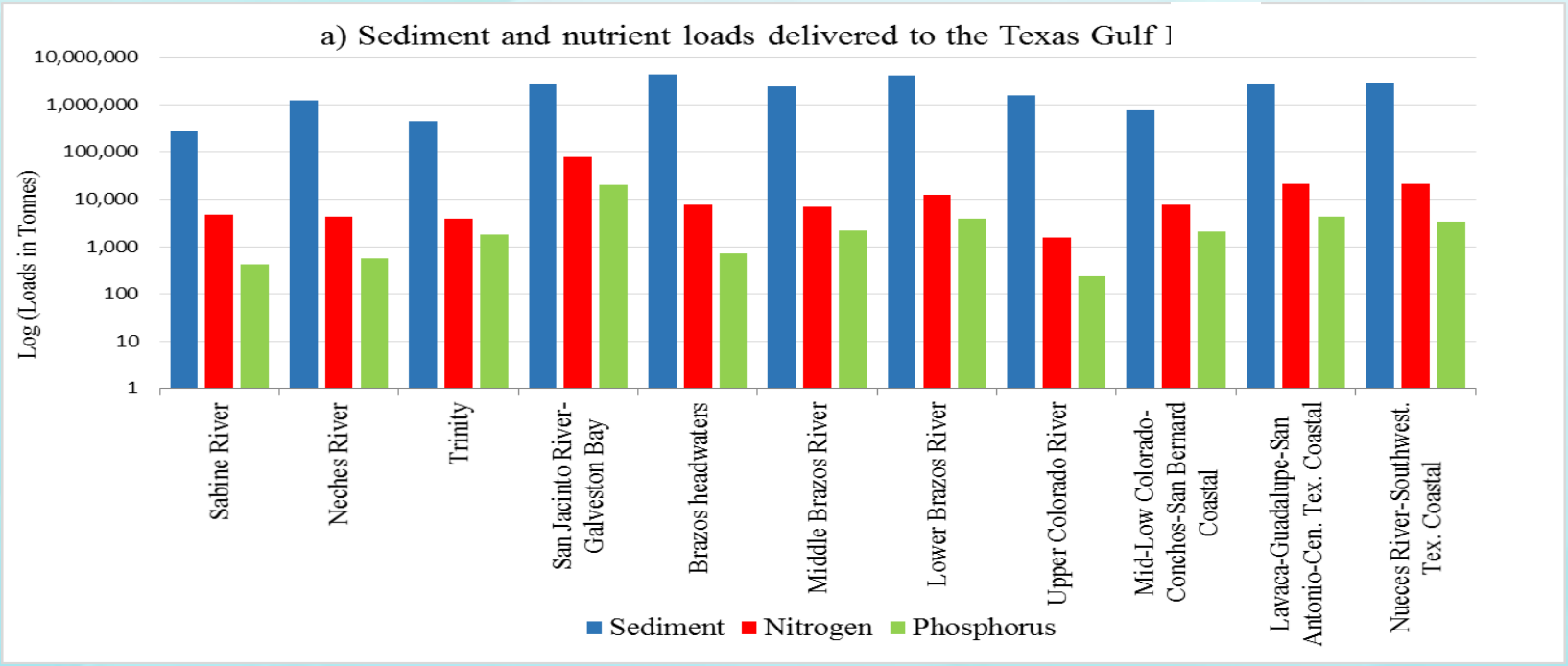


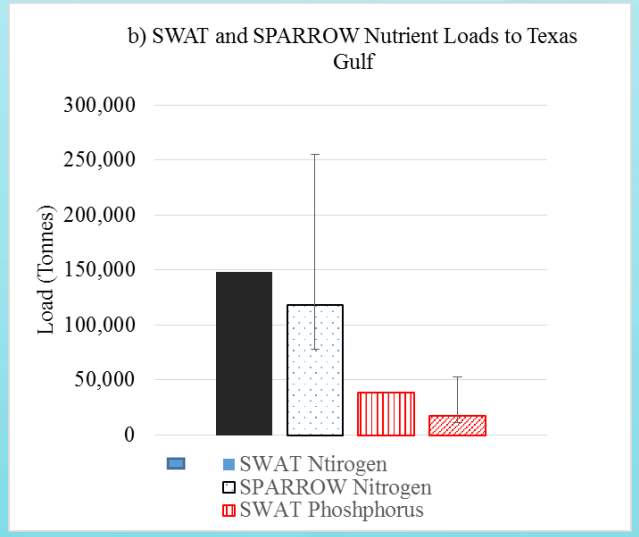


Specific Objectives

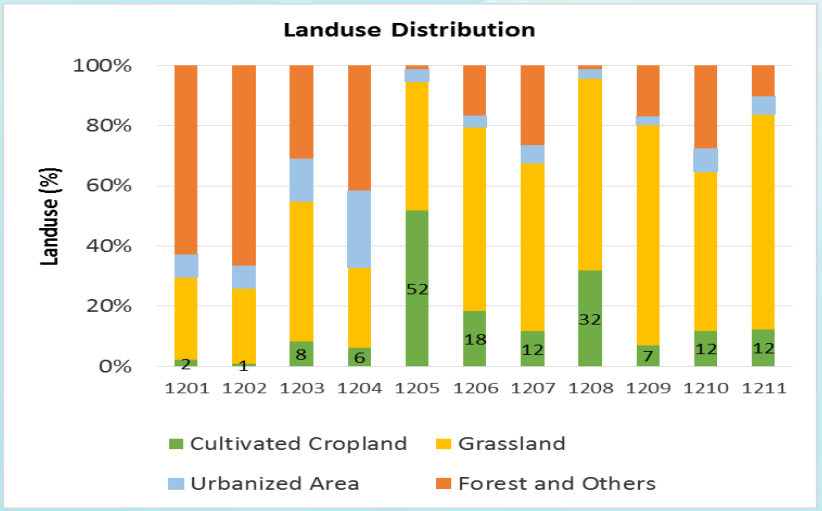
1) Estimate the sediment and nutrient loads discharged to the Texas Gulf,
2) Determine the major sources of sediment and nutrients delivered to local waters in the Texas Gulf Basin, and
3) Evaluate the effects of the current agricultural conservation and future conservation needs on water quality in the Texas Gulf Basin

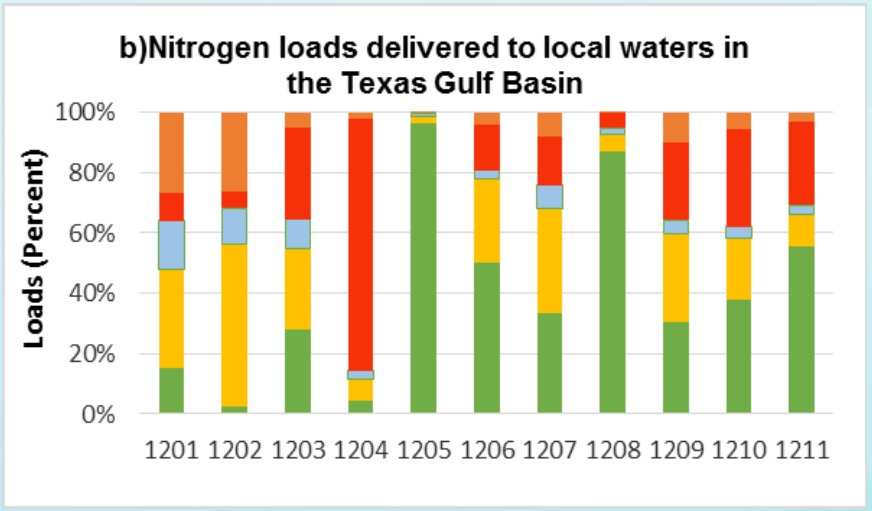
Loads Discharged from Texas Gulf Basin Prediction and Validation

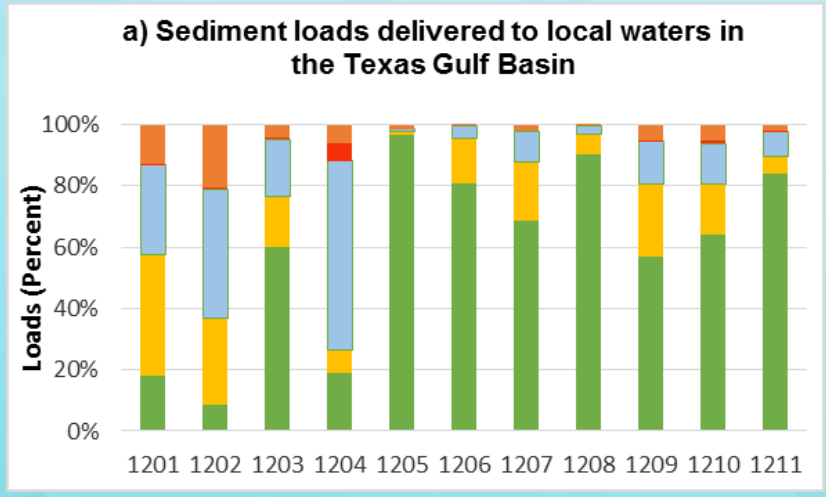


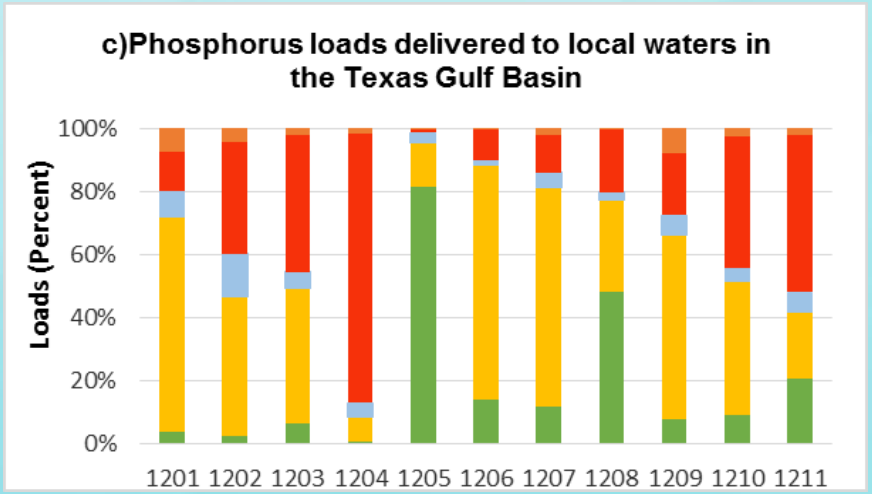


Major Sources of Sediment and Nutrients









Practices Simulated Within APEX

a) Structural Practices

In-field Practices for erosion control

- Contour Farming
- Strip Cropping
- Contour Buffer Strips
- Terraces
- Grass Terraces
- Tile Drain
- Grade Stabilization Structures
- Grassed Waterways
- Diversion

Edge of Field Practices for buffering

- Filter Strips
- Riparian Forest Buffers
- Riparian Herb. Cover
- Field Borders
- Vegetative Barrier

Wind Erosion Control Practices

- Windbreak / Shelterbelt
- Herbaceous Wind Barrier
- Hedgerow planting
- Cross Wind Practices

b) Cultural/Agronomical Management Practices

Residue, tillage, nutrient, pesticide and irrigation management practices and cover crops

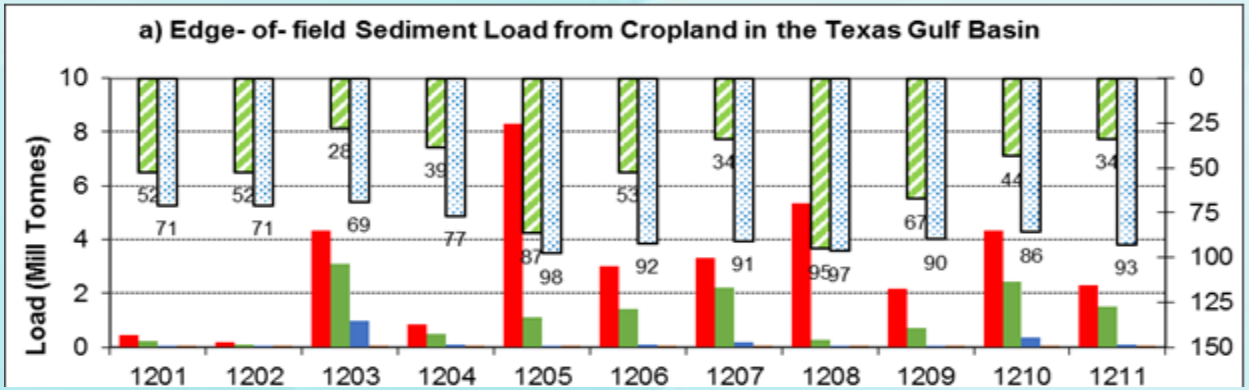
c) Long-term conservation cover (CRP) Practices

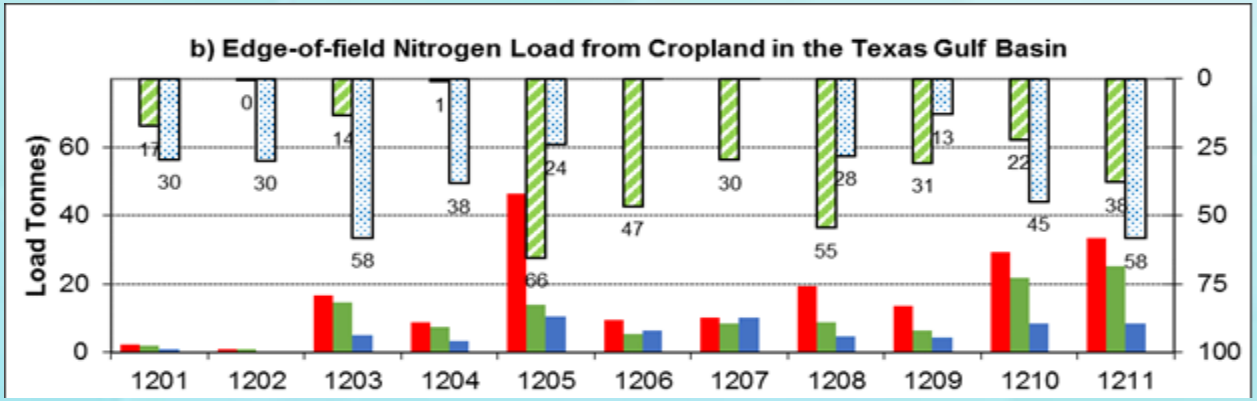
Conservation Practice Scenarios

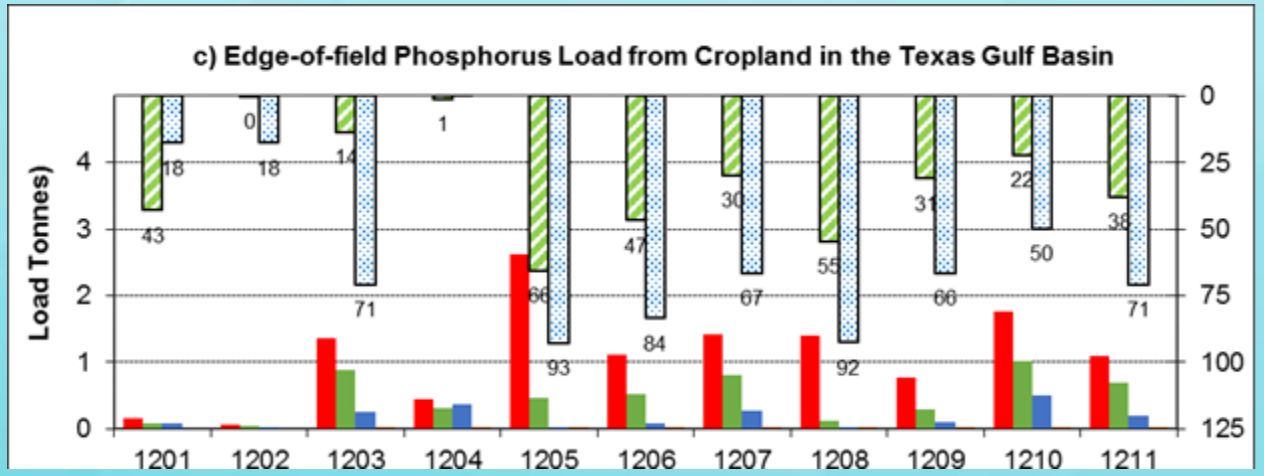
Scenarios	Practice Details
No Practice	No conservation practices on cropland
Current Conservation Condition (Baseline)	Currently existing conservation practices on cropland
Enhanced Nutrient Management on all under-treated cropland (ENMA)	Combinations of erosion control and nutrient management practices on under-treated cropland area; These areas have losses more than acceptable level.
Background	Grass-Tree mix grown on cropland in stead of crops. No fertilizer or manure. No cultivated cropland contribution

Texas Gulf Basin Area	4,70,805 km^2
Cropland & CRP	15% (70,620 km^2)

Edge of Field Water Quality Benefits: Conservation Scenarios







No Practice

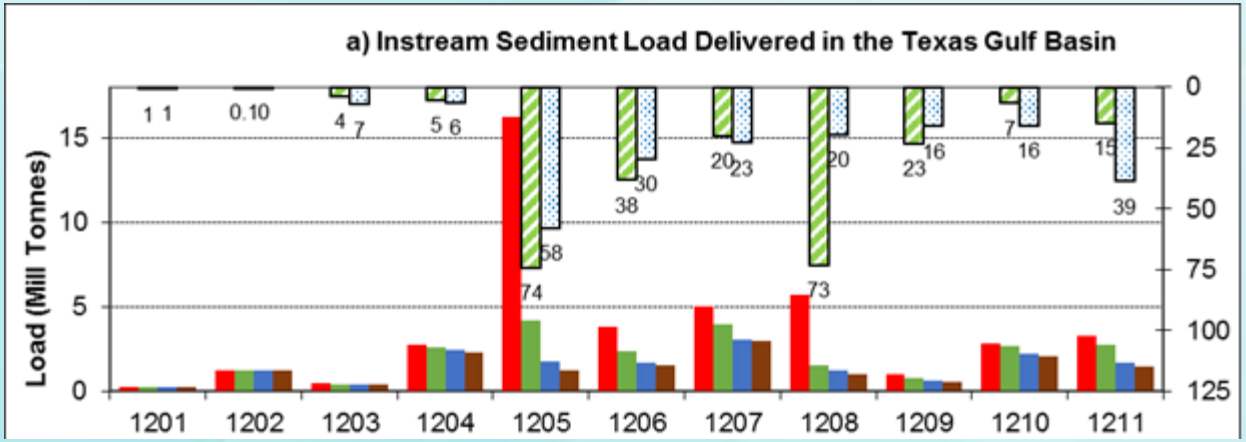
Current Conservation Condition

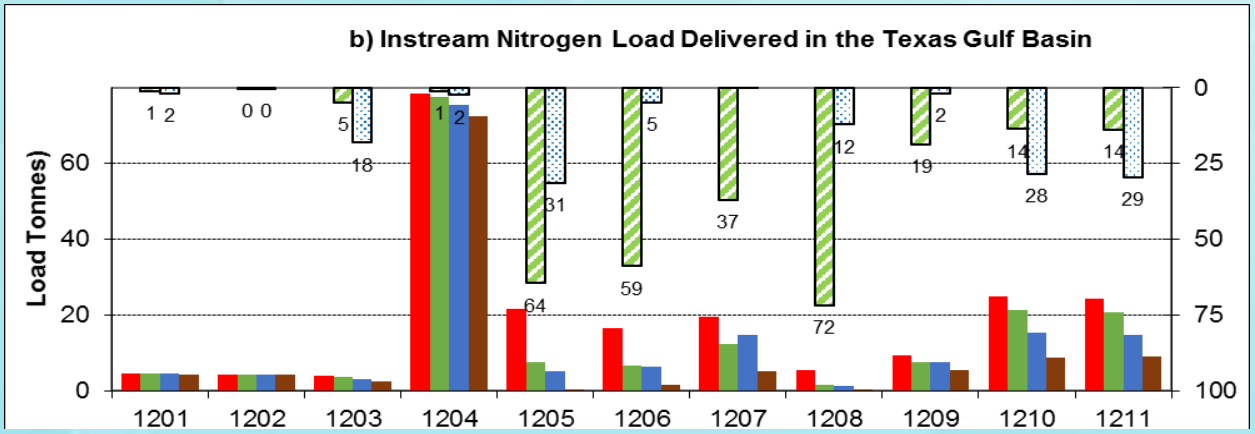
ENMA

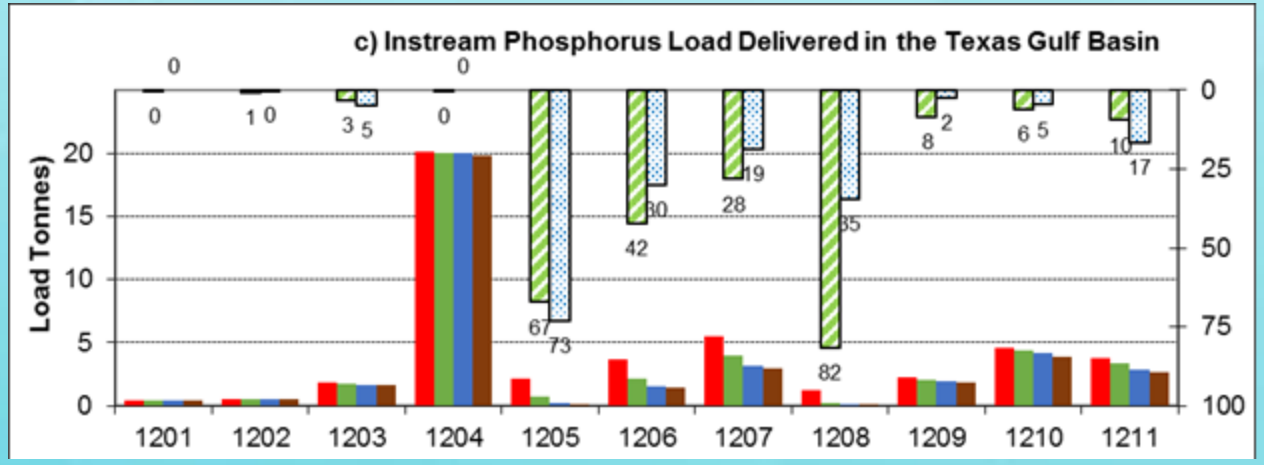
Current Conservation Reduction

ENMA Reduction

Instream Water Quality Benefits: Conservation Scenarios







- No Practice
- Current Conservation Condition
- ENMA
- Current Conservation Reduction
- ENMA Reduction
- Background

Conclusions

- Conservation practices reduces field level losses of sediment, nutrients and pesticides. They also improve the water quality of streams and rivers, lakes and other water bodies.

- Targeting critical acres improves effectiveness of conservation practices significantly.

- How far existing conservation programs have benefited: Benefits of future conservation programs indicate where to focus on future programs to be more effective.

- Magnitude and location of major sources of sediment and nutrient pollution in Texas Gulf Basin help in water quality programs such as TMDL, 319 and other CWA programs.

Conclusions

- A research methodology is developed for regional/large scale assessment using models and large databases. Researchers and modelers can adopt this.

- Tools available to study other emerging issues on eutrophication, hypoxia, algae blooms, climate change, future conservation programs, and restoration efforts.


Thank you !!!