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Demonstration of Best Management Practices for the Protection and Improvement of the Soil and Water Resources in the Arkansas Delta

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Arkansas Water Resources Center

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Submitted to the
Arkansas Soil and Water Conservation Commission

By

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Final Report to Arkansas Soil and Water Conservation Commission
Little Rock, AR

December, 2000

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INTRODUCTION

This report is the compilation of a multi-year project that was directed at identifying the impact and possible mitigation solutions of non-point pollution from row crop agriculture in a watershed in the Arkansas Delta. The first part of the project involved an inventory of the condition of the major streams that make up the study watershed. The remainder of the project was focused at demonstrating and reporting best management nutrient and sediment runoff control practices (BMP) that could be implemented. The final assessment of the demonstration work is a GIS analysis that provides an overview of the effectiveness of these BMP control measures based on the conditions of the study watershed.

Stream Inventory Background

Agriculture's use of the rich Mississippi River alluvial and lossial soil in eastern Arkansas challenges the maintenance and function of its extensive network of wetlands and streams. This agronomic presence is known to alter area stream quality from significant input of nitrogen and phosphorus based fertilizers being applied to facilitate crop growth as well as excessive soil erosion rates from currently employed tillage practices.

One way to estimate the relative economic tradeoff between profitability and sustainable resource management involves monitoring relative stream condition before and after implementation of proposed best management practices. Biological monitoring that incorporates the systematic use of stream community responses can be used to evaluate changes in the environment as well as provide surveillance of ongoing changes that could be linked with improved management practices. Surveillance monitoring of benthic

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communities has been successfully used to indicate effectiveness of both water resource management techniques (Rosenberg and Resh, 1993; Abel, 1989) and conservation measures (Hellawell, 1986).

The St. Francis River in eastern Arkansas has received historic (Meek, 1896) and more recent attention (Cochran and Harp, 1990; Cochran et al., 1993) for the benthic communities associated with its altered habitats. It originates in southeastern Missouri and flows south for 760 km in Arkansas bordered on the west by Crowley's Ridge and the east by the Mississippi River before entering the Mississippi River near Helena, Arkansas. Bottomland hardwood is the dominant forest type of this area, although most of the timber has been removed and the cleared areas utilized for agricultural production (ADPCE, 1987). The river has been substantially altered by local landowners and the US Corps of Engineers to drain 13,446 km^2 of adjacent agricultural land in the extremely flat watershed (Posey, 1997). Numerous manmade waterways, such as the Oak Donnick-St. Francis Floodway, divide the river into two separate channels from Marked Tree (RM 155) to the confluence of the L'Anguille River (RM 11.45). Water is removed from dredged channels above Marked Tree, Arkansas by large siphons and transferred into natural channels. Areas above Marked Tree and the lower stretches used in this study include both unmodified reaches and areas that have been straightened and dredged. This three-year baseline monitoring of the river is a component of a larger project intended to integrate data from demonstration fields into a geographic information system to assess watershed scale nonpoint source pollution control.

Field Demonstration Background

The lower Mississippi River Basin is some of the most productive land in the world. As such, preservation of the soil and water resources is an important consideration for both the present and future generations. Recent water quality concerns are based on nonpoint nutrient loads (Turner and Rabalais, 1991; Burkart and James, 1999). Approximately 1.8 x 10^9 kg/year of nitrogen (N) is lost from the Mississippi River Basin by means of the Mississippi River (Howarth et al., 1996). These nutrient loads have been reported to coincide with an increase in the use of N fertilizer over the last 20 years (Turner and Rabalais, 1994). An estimated 55 percent of the net N used or released to the Mississippi basin is attributed to agricultural fertilizers (Terry and Kirby, 1997). Another 26 percent is due to fixation by leguminous crops (Howarth et al., 1996).

Current agriculture practices very often do not include the use of several simple and potentially effective management practices that could help to reduce soil and nutrient loss from runoff events. The use of regulated buffer strips for deposition/infiltration and denitrification in wetlands may decrease the N loss through runoff (Crumpton and Baker, 1993). Restoration of a riparian buffer area has successfully shown to significantly decrease the concentrations of total suspended solids (92%), total phosphorus (73%), ammonia-N (25%), nitrate-N (83%), and total-N (70%) in overland flow (Clausen et al., 1999). The objective of this study was to demonstrate the effectiveness of soil and water conservation best management practices on a farmer's field cropped to cotton. Another important aspect of this study is that these protection measures would have the ability to be integrated profitably within current farming practices.

METHODS AND MATERIALS

Stream Inventory Methods

Six sites were studied from July to August during 1996-1998 for aquatic macroinvertebrates and water quality conditions that occurred in the lower St. Francis River 27 km downstream of the L'Anguille River confluence in the reach from Forrest City to Marianna, Arkansas (Table 1).

Table 1. Description of sampling locations for macroinvertebrate communities in the St. Francis River watershed from 1996-1998.

Site	Location	Coordinate
Marianna	600m downstream from Highway 79	34.47.252N 90.43.219W
L'Anguille	400 m downstream of confluence	34.46.410N 90.41.920W
Huxtable	4 km upstream from Huxtable Dam and Pumping Station	34.44.037N 90.37.229W
Soudan	1.6 km downstream from Hwy. 79	34.50.578N 90.37.978W
Madison	7.5 km downstream from Hwy. 50	34.58.590N 90.41.012W
Widener	9.9 km downstream from Hwy. 50	(Not available)

Sites designated as Widener, Soudan, and Huxtable were selected for communities that would represent unchannelized conditions in a section of the river referred to locally as the St. Francis Cutoff (Fig. 1). The remaining sites represented the modified reaches.

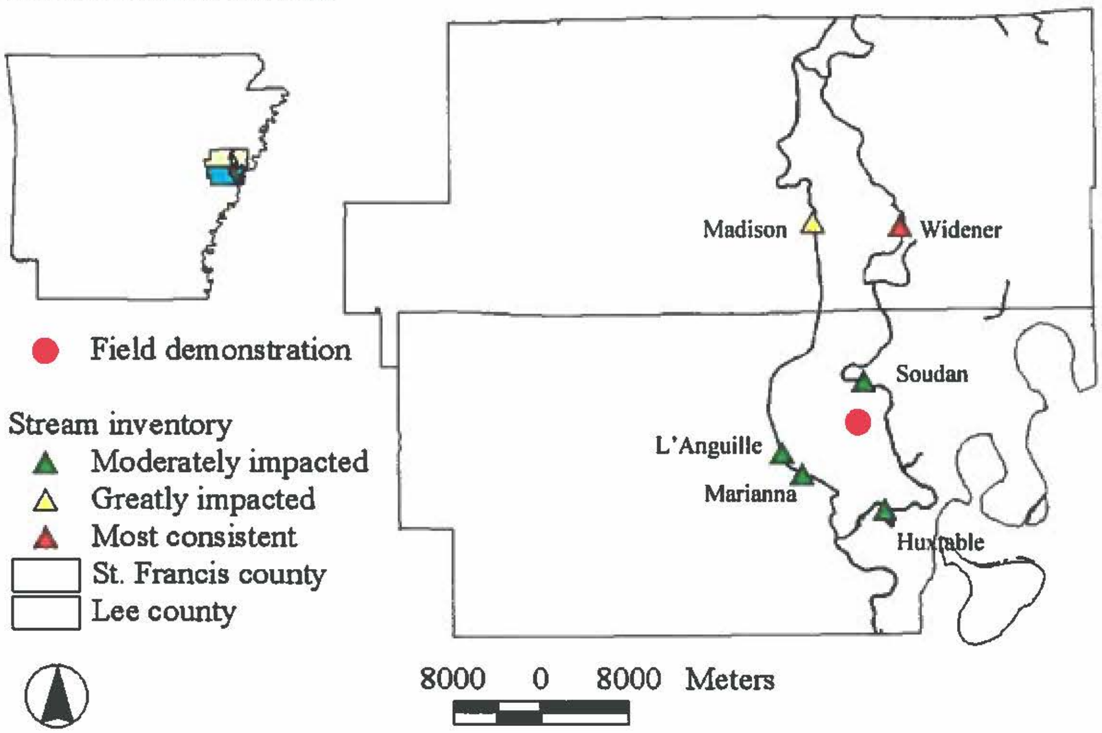
A quantitative assessment of the St. Francis River macroinvertebrate community was conducted using artificial substrates or Hester Dendy samplers. Using boats, two groups of three samplers attached to concrete cinder blocks were lowered into the substrate approximately 22.8 m perpendicular to the bank. Samplers and blocks were anchored to the riverbank for aid in retrieval following a 30-day colonization period. Upon retrieval, organisms were washed from the plate samplers into a #40 sieve bucket, and preserved in 70% ethanol for later enumeration and identification. The macroinvertebrates were identified to the lowest practical taxonomic level (most often as genera) with the aid of published keys and records. Abundance values were calculated from each of the 3 replicate samplers at each site. These results were presented as total numbers per 1 square meter. The relative abundance as a percent of each taxon was calculated at each site. Comparisons of abundance, diversity and taxon groups were made for each of the sampled sites.

Physicochemical parameters were measured at the beginning and end of the colonization period. These parameters included temperature, pH, dissolved oxygen, conductivity, nitrate, nitrite, phosphorus, alkalinity, hardness, flow rate, and turbidity. All parameters were measured in the field except for alkalinity and hardness, which were determined in the laboratory.

Field Demonstration Methods

The field used for this demonstration study is located in Soudan, Arkansas in the St. Francis River watershed (Fig. 1). The terrain is gently undulating with enough slope to create significant erosion problems from a heavy rainfall. The operator of the farm managed all production practices and inputs. The field is approximately 170 acres with six drainage ditches. All the drainage flowed across the field in an east to west direction. Autosamplers were set at each drainage outlet and programmed to collect runoff samples at the onset of a 1-inch flow created by a rainfall event. Grab samples were used to obtain the water samples when the autosamplers failed to work. Water samples were collected in one-liter bottles. Samples were analyzed for temperature, pH, and electrical conductivity (EC) in the field. The samples were sent to the Arkansas Water Resource Center Lab for total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) analyses. The samples for TN and TP analyses were preserved with 10 mL of concentrated H_2SO_4.

Figure 1. Locations of the stream inventory sites and the field demonstration in the St. Francis River watershed in eastern Arkansas.



Several best management practices (BMP) were utilized on exactly half of the demonstration field. Each half of the field contains three of the six drainage ditches. Reduced tillage was already a part of the management scheme on this farm. The main tillage factor was the elimination of disking the field in the spring just prior to forming the rows. Instead, rows were formed in the fall after harvest and left as a stale seedbed for planting in the spring. The other best management practices were grassed ditches, a lightly seeded winter cover crop of wheat, and, when possible, variable P fertilizer application based on soil samples collect every acre.

GIS Assessment Methods

All of the information collected from this field and other information within the watershed were placed in a geographic information system (GIS). SPOT Corporation 20-m multispectral satellite imagery from 1995 was used to classify the crops in the watershed. The soil series for Lee County within the St. Francis River watershed was digitized using the GIS (USDASCSFS, 1977). Cotton and soybean acreage within the watershed was calculated for each soil type. The Revised Universal Soil Loss Equation (RUSLE), $A = R*K*L*S*C*P$, was applied to Lee County within the watershed. A is the computed spatial average soil loss and temporal average soil loss expressed in tons/acre/year. R is the rainfall-runoff erosivity factor. It is determined from the rainfall erosion index plus a factor for any significant runoff from snowmelt. K is the soil erodibility factor. This is the soil loss rate per erosion index unit for a specified soil as measured on a standard plot. A standard plot is defined as 72.6 ft (22.1 m) length of uniform 9% slope in continuous clean-tilled fallow. L is the ratio of soil loss from the field slope length to soil loss from a 72.6 ft length under identical conditions. S is the ratio of soil loss from the field slope gradient to soil loss from a 9% slope under otherwise identical conditions. The cover-management factor, C, is the ratio of soil loss from an area with specified cover and management to soil loss from an identical area in tilled continuous fallow. The support practice factor, P, is the ratio of soil loss with a support practice such as contouring, stripcropping or terracing, to soil loss with straight row farming up and down the slope.

RESULTS AND DISCUSSION

Stream Inventory Results

Forty-three taxa representing twelve orders of benthic macroinvertebrates were identified from samplers allowed to colonize at the six sites in the study reach. Communities from the modified reaches at Marianna, L'Anguille, and Madison had moderately impacted communities as represented by diversity indices (H') that were all below 2.07 (Table 2). Total taxa collected and community diversity indices for all sites, during all summers sampled were half those values reported for least-distributed reference streams in the Arkansas Delta Ecoregion assessed during similar summer flows (ADPCE, 1987). The benthic community monitored at Madison also experienced the greatest reduction in both total taxa and abundance during the three-year study. Modified channels within this reach had a clay to unstable sandy bank substrate, high turbidity, a lack of aquatic vegetation and a moderate to fairly swift current. The variability in community characteristics from year to year is typical of disturbed stream segments and has been attributed to seasonal influence of rainfall specifically for this riverine habitat (Cochran and Harp, 1990). This instability in channeled sections has been illustrated by low numbers of taxa, individuals, and diversity indices similar to that found in the present surveillance.

Benthic communities characterized for the Widener site provided the most consistent measure of community stability within the study reach. While the Widener community was representative of the undisturbed St. Francis Cutoff, substrate and habitat alone were not enough to support an improved community over those for channeled segments. Both Huxtable and Soudan benthic communities had low diversity values for both 1996 and 1997 and high percent dominant taxa suggested that river conditions selected for a community structured by high erosion. Mobility of sediments and transport of particulates during the three monitoring periods were both dominant factors structuring the colonization of benthic organisms at all sites. While there were no apparent limiting physicochemical factors for sites having exceptionally low community indices, the Huxtable and Soudan sites did both have higher turbidity values and temperatures that approached the thermal maxima for many aquatic organisms (Table 3). Fortunately, the

St. Francis River seems to support a high dissolved oxygen content even during low summer flows.

Table 2. Community indices for benthic macroinvertebrates colonizing artificial substrates at six sites in the lower St. Francis River.

	Marianna	L'Anguille	Huxtable	Soudan	Madison	Widener
1996						
Total Taxa	27	27	8	13	33	26
Abundance/m^2	4,677	8,385	4,977	4,969	30,785	2,069
(%) Dominant Taxa	48.2	56.1	93.3	90.4	58.5	40.4
Shannon Diversity (H')	2.07	1.78	0.94	1.11	1.71	2.47
1997						
Total Taxa	12	17	11	10	8	21
Abundance/m^2	5,262	3,562	1,046	2,008	246	3,908
(%) Dominant Taxa	75.5	63.8	95.6	90.9	54.2	52.5
Shannon Diversity (H')	1.32	1.56	0.95	1.10	1.85	1.90
1998						
Total Taxa	12	9	11	14	5	15
Abundance/m^2	862	562	1,454	1,592	246	877
(%) Dominant Taxa	58.8	71.2	71.7	57.5	86.1	45.5
Shannon Diversity (H')	1.69	1.40	1.40	1.70	1.20	2.20

Table 3. Mean physicochemical parameters measured during benthic macroinvertebrate monitoring of the lower St. Francis River, 1996-1998.

Parameter	Marianna	L'Anguille	Huxtable	Soudan	Madison	Widener
Dissolved O_2 (mg/L)	6.4 (±0.7)	5.8 (±0.6)	6.9 (±1.8)	7.0 (±2.2)	6.7 (±0.7)	6.6 (±2.0)
pH	7.4 (±0.7)	7.2 (±0.5)	7.4 (±0.7)	7.5 (±0.7)	7.3 (±0.6)	7.5 (±0.7)
Conductivity (μS/cm)	244 (±99)	294 (±160)	288 (±113)	298 (±97)	213 (±145)	296 (±117)
Temperature (°C)	28.6 (±1.9)	28.6 (±2.0)	30.7 (±2.7)	30.4 (±3.2)	29.3 (±2.4)	29.2 (±2.6)
Turbidity (NTU)	81.0 (±57.2)	56.9 (±58.7)	90.7 (±73.0)	93.3 (±39.0)	61.4 (±20.2)	119.8 (±38.6)
Phosphorous (mg/L)	5.96 (±12.96)	7.61 (±14.14)	3.08 (±5.18)	2.89 (±5.54)	11.66 (±24.23)	0.94 (±0.52)
Nitrate (mg/L)	0.18 (±0.06)	7.08	1.41 (±0.47)	1.23 (±0.49)	0.31 (±0.11)	0.26 (±0.06)
Nitrite (mg/L)	0.19 (±0.08)	0.43 (±0.22)	0.53 (±0.23)	0.86 (±0.36)	0.19 (±0.04)	0.99 (±0.48)
Flow (m/sec)	0.58 (±0.47)	0.48 (±0.33)	0.25 (±0.05)	0.21 (±0.05)	0.44 (±0.40)	0.21 (±0.14)
Alkalinity ($mgCaCO_3/L$)	109 (±68)	119 (±69)	114 (±67)	116 (±71)	107 (±71)	103 (±61)
Hardness ($mgCaCO_3/L$)	120 (±62)	122 (±71)	120 (±70)	128 (±72)	117 (±68)	120 (±62)
TDS	63.5 (±89.6)	72.4 (±102.2)	74.4 (±104.8)		69.9 (±98.6)	

The sediments of the St. Francis River are repositories of accumulated nutrients and toxins that then present the sessile benthic macroinvertebrates as suitable monitors to reflect changes in the chemical, successional or pollution status of a stream (Rosenberg and Resh, 1993). Erosion whether from agricultural practices or dredging activities in the basin, often results in the introduction of substantial amounts of particulate matter. The effects of these introductions on aquatic macroinvertebrates may be quite serious since food collection or respiration can be obstructed and because the substances reduce light penetration and fill interstices within the substrate (Resh and Rosenberg, 1984). The communities sampled in this study were all impacted by habitat loss and the accompanying changes of an ecosystem that has lost the regularity and predictability of a historic guiding flood pulse. Watershed scale assessment of nonpoint source pollution control afforded by improved best management practices will be difficult in the midst of such modified conditions and impacted communities. This places even greater emphasis on integrated field measurements from demonstration plots coupled with instream responses and standardization biomonitoring techniques.

Field Demonstration Results

The results reported are based on three years of data collection. Figures 2, 3, and 4 illustrate the average total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) levels from the three drainage ditches located in the conventional production side of the field and the average of the three drainage ditches located in the BMP side of the field. An initial flush of all three parameters (TN, TP, and TSS) from both sides of the field was evident in the runoff in the spring and early summer months. This was possibly due to early pre-plant fertilizer nitrogen applications for cotton a release of mineralized soil N as the soil became warmer. Runoff nutrient and sediment levels decreased again in the cooler winter months. The BMP side of the field did not appear to be very effective except for in May and June of 1998. This was due to the termination of the grass buffer strips by a Roundup herbicide application. However, the winter wheat cover crop proved to be an easy BMP to establish and maintain (Fig. 5).

Fig. 2. Total nitrogen concentrations in the field runoff from the conventional and BMP demonstration site (numbers above each bar are the standard deviation of the mean).

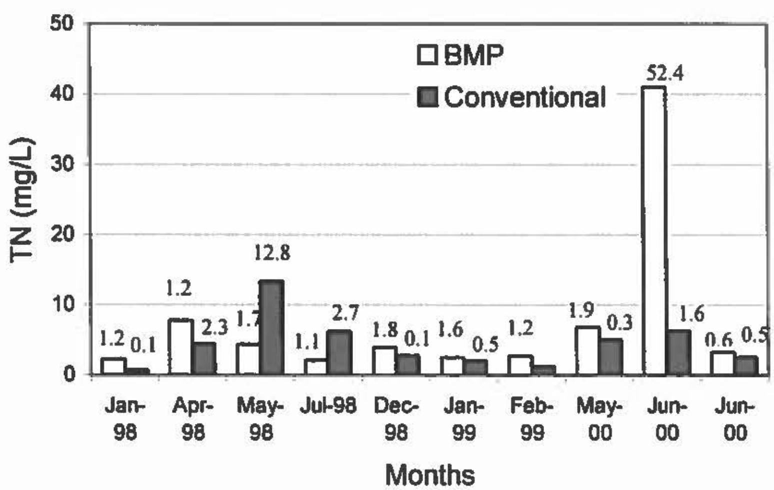


Fig. 3. Total phosphorus concentrations in the field runoff from the conventional and BMP demonstration site (numbers above each bar are the standard deviation of the mean).

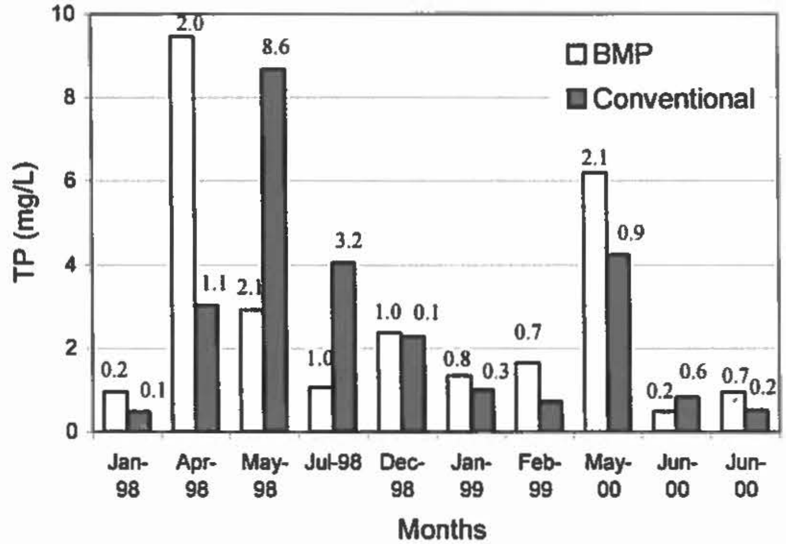


Fig. 4. Total suspended solids concentrations in the field runoff from the conventional and BMP demonstration site (numbers above each bar are the standard deviation of the mean).

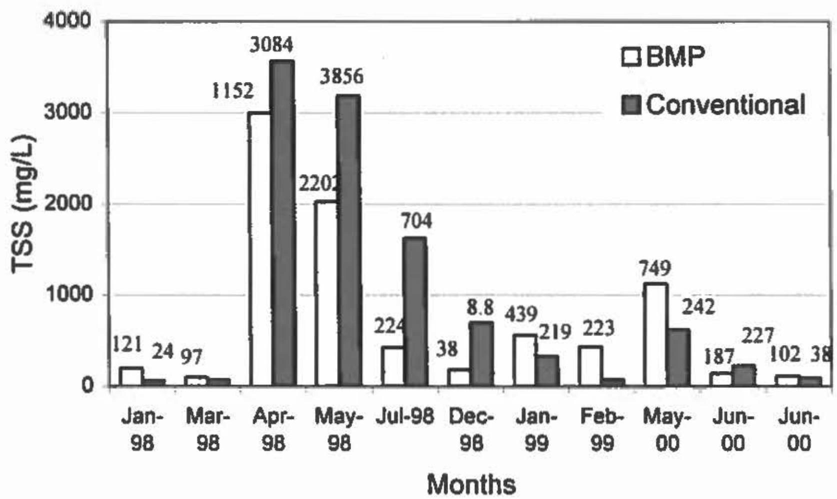


Fig. 5. Winter wheat cover crop on the demonstration field.

Results from intensively soil sampling the entire demonstration field for N and P fertility levels are shown in Figs. 6 and 7. Soil nitrate-N levels were relatively low with only a few hot spots of high concentrations scattered randomly throughout the field. Fertilizer N was recommended at a rate of 110 lb/A. This N rate is the recommended rate for irrigated cotton by the Arkansas Cooperative Extension Service.

A significant amount of the filed was found to be at or above an adequate level (100 lb P/A) of soiltest P for cotton yield (ACES, 1999). This portion of the field would not require additional P fertilizer to produce a cotton crop. While variable rate is a valid option, at the present time, the cost of variable rate applications have not been found to be cost effective. Thus, the P fertility of this site was managed as a field average. This field was well below the recommended limit (300 lb P/A) that would prohibit the use of P fertilizer. Thus, only the lowest recommended rate of P fertilizer (30 lb/A) would be required and was suggested as the nutrient management practice for P in the study field.

GIS Assessment Results

The GIS assessment was applied to the lower half (Lee County, AR) of the St. Francis River watershed due to the location of the demonstration field. Figure 8 illustrates the relationship of the watershed to the Mississippi Delta as well as the sediment flowing into the Gulf of Mexico by way of the Mississippi River. The bright green areas indicate high concentrations of sediment. Figure 9 illustrates the multispectral satellite imagery used to determine the crop classification of the St. Francis River watershed shown in Fig. 10.

Fig. 6. Map of the demonstration field soil test nitrate-nitrogen.

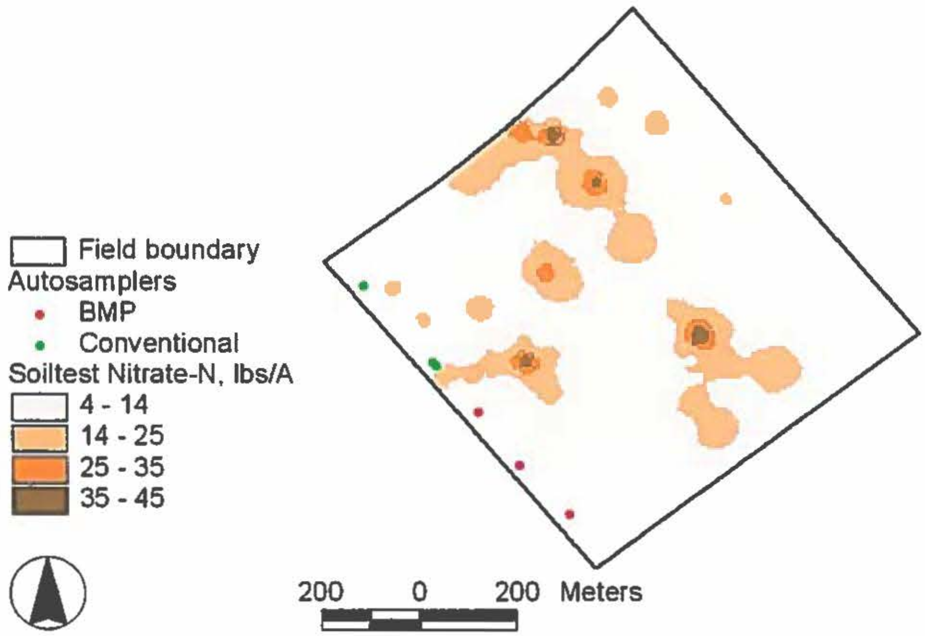


Fig. 7. Map of the demonstration field soil test phosphorus.

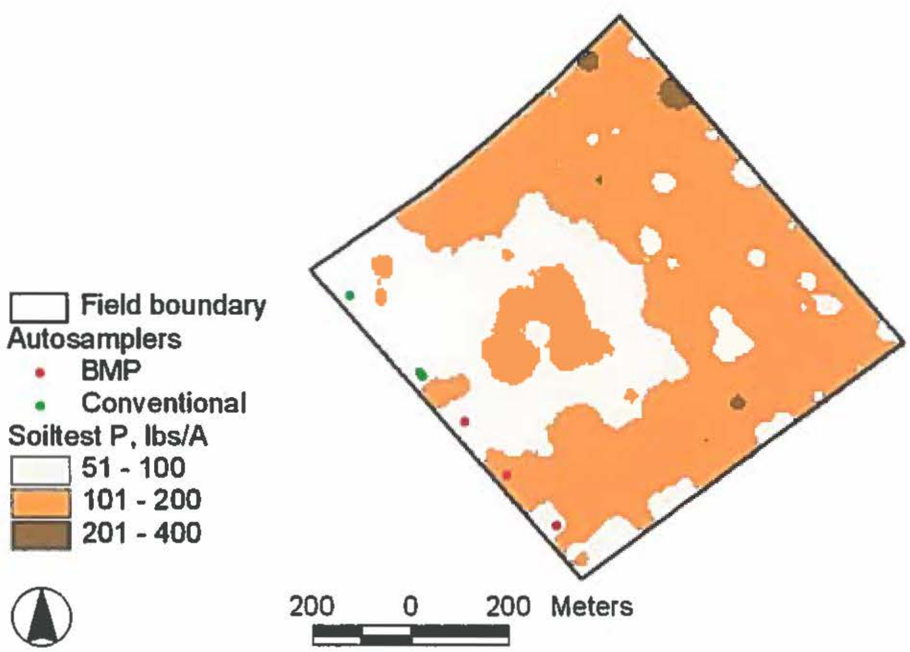


Fig. 8. Mississippi River sediment in Louisiana and Mississippi flowing into the Gulf of Mexico.

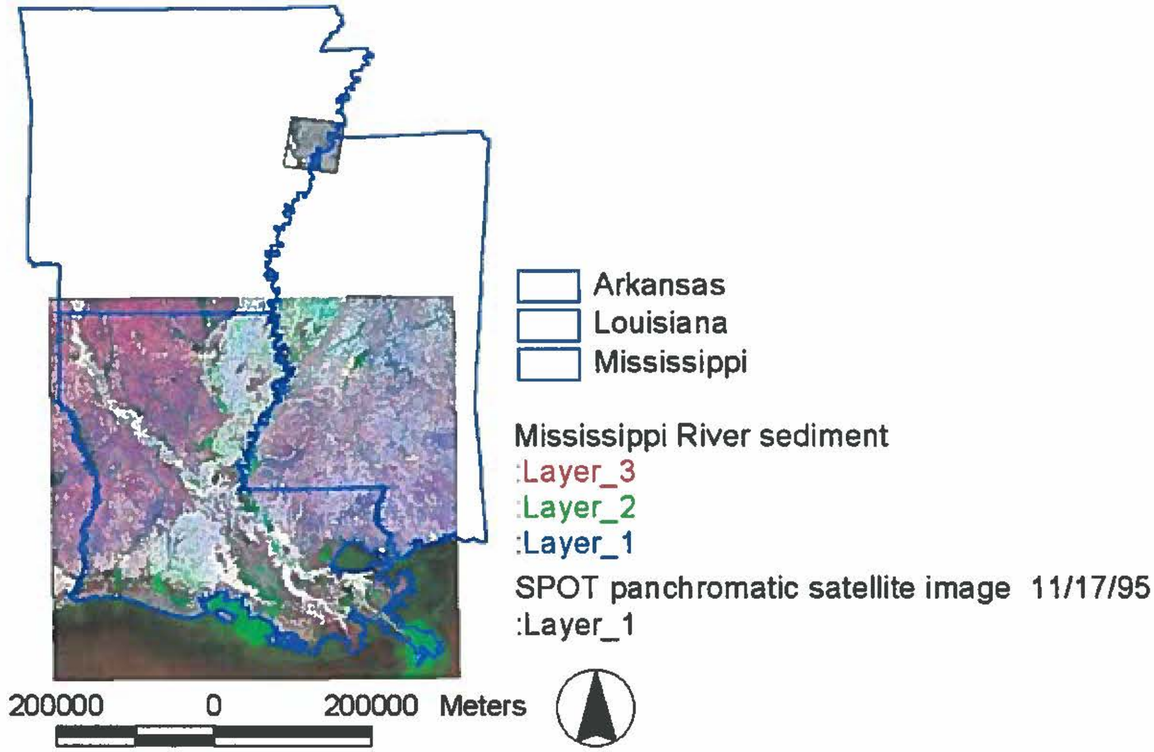


Fig. 9. Multispectral satellite imagery, 8/15/95, used to classify the St. Francis River watershed in Lee County.

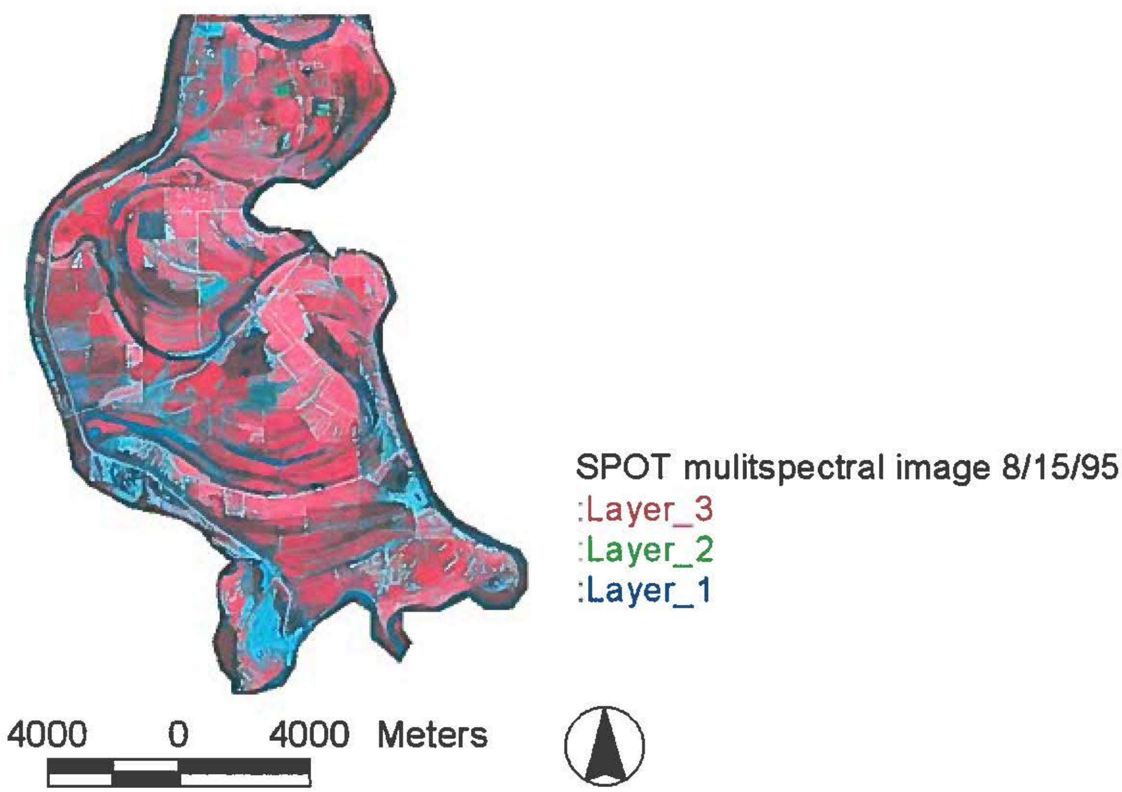
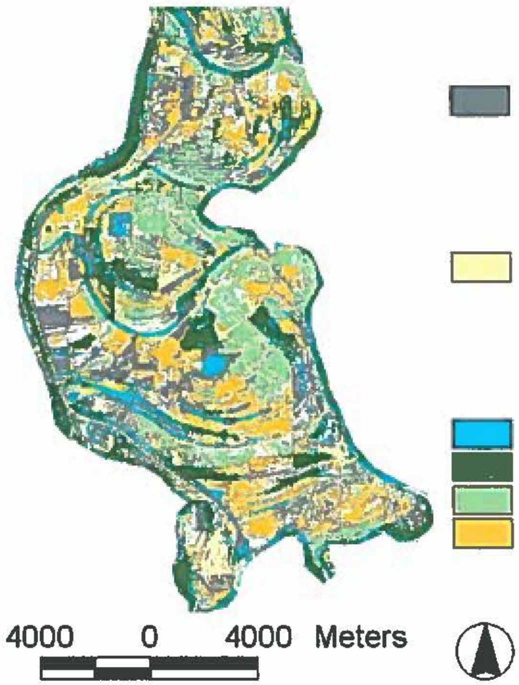


Fig. 10. Crop classification of the St. Francis River watershed in Lee County.



The light red areas in the satellite imagery indicate cotton fields, while the darker red areas indicate soybean fields. Soybeans and cotton were the two major crops grown in Lee County. Cotton and soybeans by soil series in Lee County are shown in Figs. 11 and 12, respectfully. The total acreage of cotton in Lee County in the watershed is 11,140 acres and the total acreage of soybeans is 13,307 acres.

Fig. 11. Cotton classification by soil series in the St. Francis River watershed in Lee County.

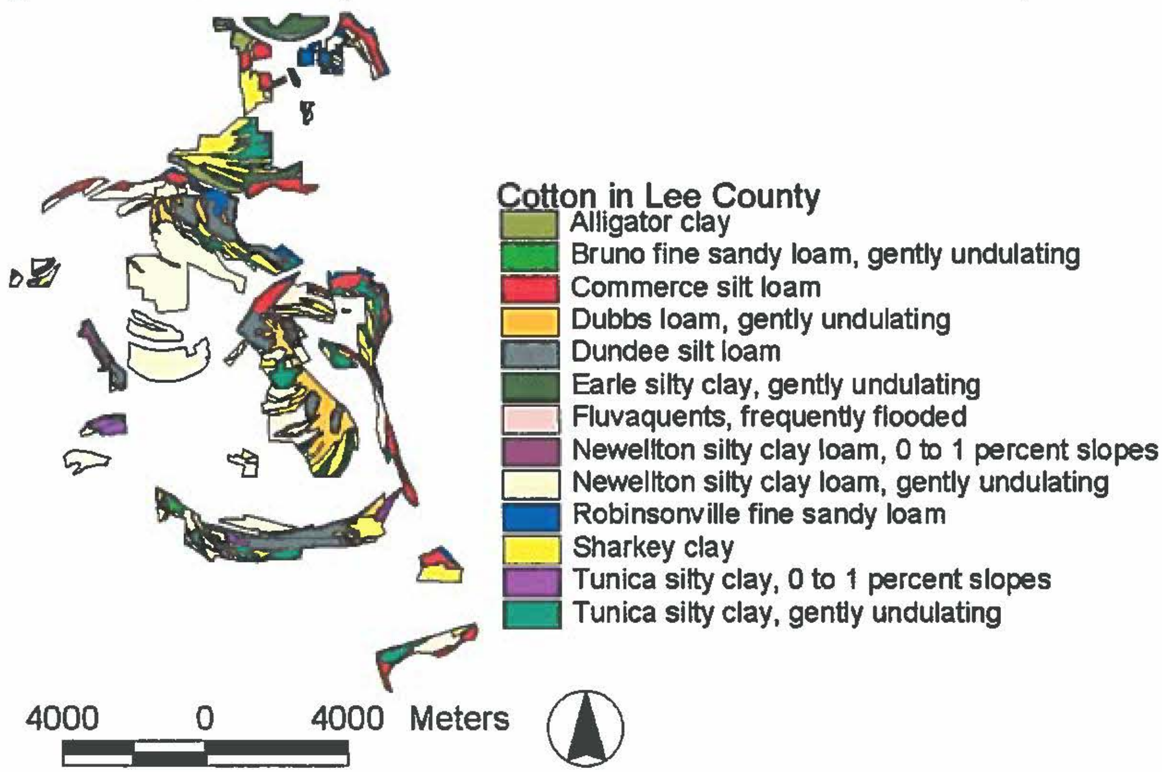
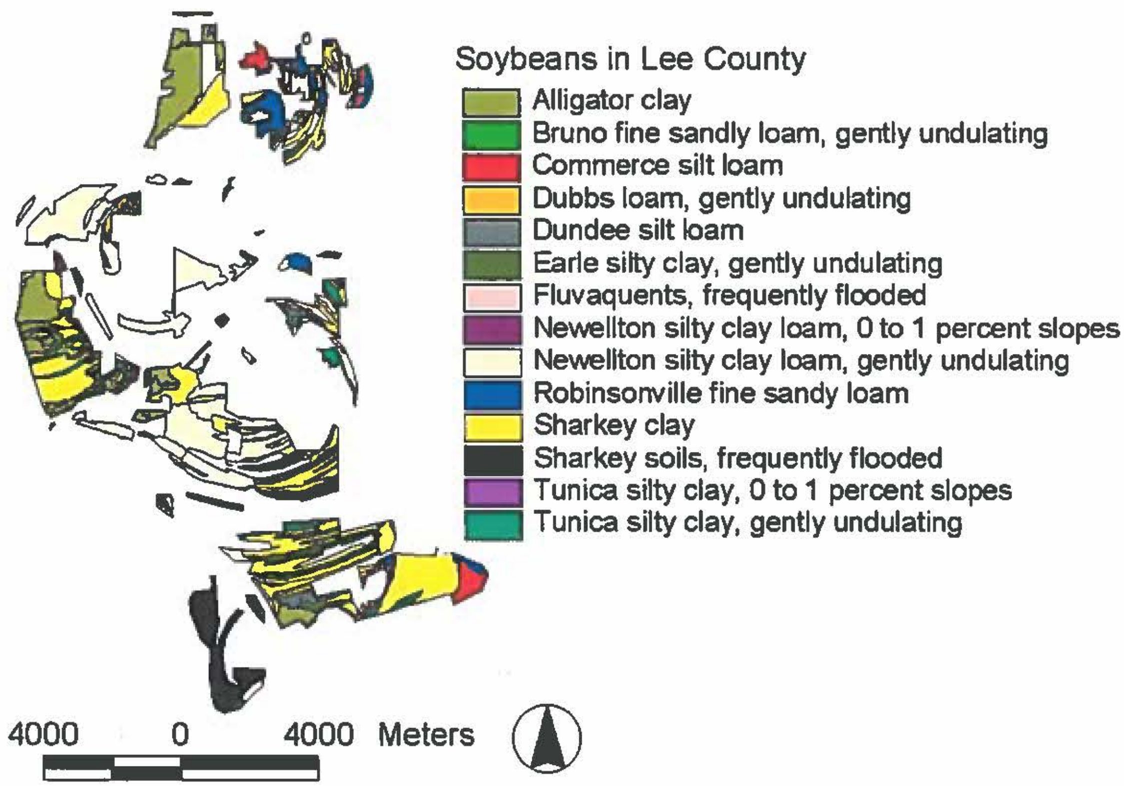


Fig. 12. Soybean classification by soil series in the St. Francis River watershed in Lee County.



RUSLE is a model designed to predict the longtime average annual soil loss carried by runoff from field slopes in certain cropping and management systems. The RUSLE equation was applied to the lower half (Lee County) of the watershed with varying scenarios. The acceptable A value using RUSLE is less than one ton/acre/year (NRCS, 1995).

Table 4 illustrates that if a farmer planted cotton on 38 in. rows with an expected yield of 750 lb/A lint, using the described method, the A value would be 3.86 tons/acre/year, which would not be acceptable. A simple conservation practice such as rebedding the old rows after harvest and broadcasting a winter wheat cover crop was found to decrease the A value to 1.86 tons/acre/year (Table 5).

Table 6 illustrates an A value of 1.57 tons/acre/year on a no-till cotton field, planted flat with total weed control. Although none of these values are below one ton/acre/year, planting incorporating a BMP such as a winter wheat cover crop, rebedding the old rows, or doing no-till, drastically decreased the amount of soil that eroded in this watershed.

Table 7 illustrates that planting 35 bushel/A yield soybeans on 38 in. rows while using conservation tillage and light winter weeds resulted in an A value of 3.76 tons/acre/year. Planting 35 bushel/A yield soybeans on 19 in. rows and going no-till with light winter weeds decreased the A value to an acceptable 0.97 tons/acre/year (Table 8).

Table 4. Cotton-Conservation tillage, delay tillage until 4 weeks before planting on 38" rows , expected yield of 750 lb/A lint.

Soil Type	Acres	H,L,G	T-val	R	K	L	S	(L,S)	C	P	A=t/yr	Tons lost	Acc. Slope
Ac	218.3	D	5	310	0.32	1000	1	0.20	0.27	0.64	3.43	748.41	218.3
BrB	91.5	A	3	310	0.17	1000	1	0.20	0.27	0.61	1.74	158.84	91.5
Cm	1191.6	C	5	310	0.43	1000	1	0.20	0.27	0.63	4.53	5403.75	1191.6
DsB	788.0	B	5	310	0.37	1000	1	0.20	0.27	0.63	3.90	3074.85	788
Du	1449.9	C	5	310	0.43	1000	1	0.20	0.27	0.63	4.53	6575.10	1449.9
EaB	464.1	D	5	310	0.32	1000	1	0.20	0.27	0.64	3.43	1591.10	464.1
Ff	101.5	A	5	310	0.32	1000	1	0.20	0.27	0.61	3.27	331.67	101.5
NeA	91.2	D	5	310	0.37	1000	1	0.20	0.27	0.64	3.96	361.52	91.2
NeB	3369.6	D	5	310	0.37	1000	1	0.20	0.27	0.64	3.96	13357.2	3369.6
Ro	445.4	B	5	310	0.28	1000	1	0.20	0.27	0.63	2.95	1315.24	445.4
Sh	1892.7	D	5	310	0.32	1000	1	0.20	0.27	0.64	3.43	6488.84	1892.7
TnA	201.1	D	5	310	0.32	1000	1	0.20	0.27	0.64	3.43	689.44	201.1
TnB	835.7	D	5	310	0.32	1000	1	0.20	0.27	0.64	3.43	2865.07	835.7
		Acceptable T	4.8								Wt. Ave.	3.86	1.00

Table 5. Cotton - Rebed old rows after harvest, wheat cover crop, spray April 1st, do-all, plant on 38" rows, 750 lb/A lint yield.

Soil Type	Acres	H,L,G	T-val	R	K	L	S	(L,S)	C	P	A=t/yr	Tons lost	Acc. Slope
Ac	218.3	D	5	310	0.32	1000	1	0.20	0.13	0.64	1.65	360.35	218.3
BrB	91.5	A	3	310	0.17	1000	1	0.20	0.13	0.61	0.84	76.48	91.5
Cm	1191.6	C	5	310	0.43	1000	1	0.20	0.13	0.63	2.18	2601.80	1191.6
DsB	788.0	B	5	310	0.37	1000	1	0.20	0.13	0.63	1.88	1480.48	788
Du	1449.9	C	5	310	0.43	1000	1	0.20	0.13	0.63	2.18	3165.79	1449.9
EaB	464.1	D	5	310	0.32	1000	1	0.20	0.13	0.64	1.65	766.08	464.1
Ff	101.5	A	5	310	0.32	1000	1	0.20	0.13	0.61	1.57	159.69	101.5
NeA	91.2	D	5	310	0.37	1000	1	0.20	0.13	0.64	1.91	174.07	91.2
NeB	3369.6	D	5	310	0.37	1000	1	0.20	0.13	0.64	1.91	6431.25	3369.6
Ro	445.4	B	5	310	0.28	1000	1	0.20	0.13	0.63	1.42	633.26	445.4
Sh	1892.7	D	5	310	0.32	1000	1	0.20	0.13	0.64	1.65	3124.26	1892.7
TnA	201.1	D	5	310	0.32	1000	1	0.20	0.13	0.64	1.65	331.95	201.1
TnB	835.7	D	5	310	0.32	1000	1	0.20	0.13	0.64	1.65	1379.48	835.7
		Acceptable T	4.8								Wt. Ave.	1.86	1.00

Table 6. Cotton – No-till, planted flat, total chemical weed control, plant on 38" rows with an expected yield of 750 lb/A lint.

Soil Type	Acres	H,L,G	T-val	R	K	L	S	(L,S)	C	P	A=t/yr	Tons lost	Acc. Slope
Ac	218.3	D	5	310	0.32	1000	1	0.20	0.11	0.64	1.40	304.91	218.3
BrB	91.5	A	3	310	0.17	1000	1	0.20	0.11	0.61	0.71	64.71	91.5
Cm	1191.6	C	5	310	0.43	1000	1	0.20	0.11	0.63	1.85	2201.53	1191.6
DsB	788.0	B	5	310	0.37	1000	1	0.20	0.11	0.63	1.59	1252.72	788
Du	1449.9	C	5	310	0.43	1000	1	0.20	0.11	0.63	1.85	2678.75	1449.9
EaB	464.1	D	5	310	0.32	1000	1	0.20	0.11	0.64	1.40	648.23	464.1
Ff	101.5	A	5	310	0.32	1000	1	0.20	0.11	0.61	1.33	135.12	101.5
NeA	91.2	D	5	310	0.37	1000	1	0.20	0.11	0.64	1.61	147.29	91.2
NeB	3369.6	D	5	310	0.37	1000	1	0.20	0.11	0.64	1.61	5441.82	3369.6
Ro	445.4	B	5	310	0.28	1000	1	0.20	0.11	0.63	1.20	535.84	445.4
Sh	1892.7	D	5	310	0.32	1000	1	0.20	0.11	0.64	1.40	2643.60	1892.7
TnA	201.1	D	5	310	0.32	1000	1	0.20	0.11	0.64	1.40	280.88	201.1
TnB	835.7	D	5	310	0.32	1000	1	0.20	0.11	0.64	1.40	1167.25	835.7
		Acceptable T	4.8								Wt. Ave.	1.57	1.00

Table 7. Soybeans – Conservation tillage with winter weeds (light), plant on 38" rows with an expected yield of 35 bushel/A.

Soil Type	Acres	H,L,G	T-val	R	K	L	S	(L,S)	C	P	A=t/yr	Tons lost	Acc. Slope
Ac	1727.1	D	5	310	0.32	1000	1	0.20	0.18	1.00	3.57	6167.82	1727.1
BrB	23.8	A	3	310	0.17	1000	1	0.20	0.18	0.72	1.37	32.51	23.8
Cm	387.1	C	5	310	0.43	1000	1	0.20	0.18	1.00	4.80	1857.62	387.1
DsB	178.1	B	5	310	0.37	1000	1	0.20	0.18	0.90	3.72	661.87	178.1
Du	503.1	C	5	310	0.43	1000	1	0.20	0.18	1.00	4.80	2414.28	503.1
EaB	789.5	D	5	310	0.32	1000	1	0.20	0.18	1.00	3.57	2819.46	789.5
Ff	86.4	A	5	310	0.32	1000	1	0.20	0.18	0.72	2.57	222.16	86.4
NeA	106.2	D	5	310	0.37	1000	1	0.20	0.18	1.00	4.13	438.52	106.2
NeB	3349.2	D	5	310	0.37	1000	1	0.20	0.18	1.00	4.13	13829.52	3349.2
Ro	598.5	B	5	310	0.28	1000	1	0.20	0.18	0.90	2.81	1683.17	598.5
Sh	4320.9	D	5	310	0.32	1000	1	0.20	0.18	1.00	3.57	15430.8	4320.9
Sk	661.3	D	5	310	0.32	1000	1	0.20	0.18	1.00	3.57	2361.63	661.3
TnA	69.3	D	5	310	0.32	1000	1	0.20	0.18	1.00	3.57	247.48	69.3
TnB	507.2	D	5	310	0.32	1000	1	0.20	0.18	1.00	3.57	1811.31	507.2
		Acceptable T	4.8								Wt. Ave.	3.76	1.00

Table 8. Soybeans – No-till with winter weeds (light), plant on 19" rows with an expected yield of 35 bushel/A.

Soil Type	Acres	H,L,G	T-val	R	K	L	S	(L,S)	C	P	A=t/yr	Tons lost	Acc. Slope
Ac	1727.1	D	5	310	0.32	1000	1	0.20	0.05	0.94	0.93	1610.49	1727.1
BrB	23.8	A	3	310	0.17	1000	1	0.20	0.05	0.58	0.31	7.27	23.8
Cm	387.1	C	5	310	0.43	1000	1	0.20	0.05	0.87	1.16	448.92	387.1
DsB	178.1	B	5	310	0.37	1000	1	0.20	0.05	0.69	0.79	140.95	178.1
Du	503.1	C	5	310	0.43	1000	1	0.20	0.05	0.87	1.16	583.45	503.1
EaB	789.5	D	5	310	0.32	1000	1	0.20	0.05	0.94	0.93	736.19	789.5
Ff	86.4	A	5	310	0.32	1000	1	0.20	0.05	0.58	0.58	49.71	86.4
NeA	106.2	D	5	310	0.37	1000	1	0.20	0.05	0.94	1.08	114.50	106.2
NeB	3349.2	D	5	310	0.37	1000	1	0.20	0.05	0.94	1.08	3611.04	3349.2
Ro	598.5	B	5	310	0.28	1000	1	0.20	0.05	0.69	0.60	358.45	598.5
Sh	4320.9	D	5	310	0.32	1000	1	0.20	0.05	0.94	0.93	4029.15	4320.9
Sk	661.3	D	5	310	0.32	1000	1	0.20	0.05	0.94	0.93	616.65	661.3
TnA	69.3	D	5	310	0.32	1000	1	0.20	0.05	0.94	0.93	64.62	69.3
TnB	507.2	D	5	310	0.32	1000	1	0.20	0.05	0.94	0.93	472.95	507.2
		Acceptable T	4.8								Wt. Ave.	0.97	1.00

CONCLUSIONS

The GIS assessment of the St. Francis River watershed indicated that application of simple BMP's have the potential to significantly decreased the amount of soil loss on a production field. Implementation of control practices such as a winter wheat cover crop, reduced tillage, and grassed waterways would prove effective in reducing the soil loss into a nearby waterway. The water analyses indicated that the grassed waterways were effective in the spring months of 1998, while ineffective the other months of the year. The ineffectiveness of these BMP's was mainly due to the introduction new seed biotechnologies that make the establishment of in field grassed waterways very difficult.

The Arkansas Cooperative Extension Service Cotton Research Verification Program (CVRP) works with farmers towards improving cotton production. A significant part of the technical transfer of this project was directed towards this program. One positive aspect of the CRVP is that in the upcoming year, a majority of the farmers in this program have opted to incorporate reduced tillage and winter cover crops in their production fields. Based on the study GIS assessment, the conservation trend noted in the CRVP program should help to mitigate nutrient and sediment runoff attributed to agriculture in the St. Francis watershed.

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MEETINGS & SEMINARS INVOLVING BMP TECH TRANSFER

October, 1998: Southern Soil Fertility Conference. Memphis, TN.

December, 1998: Presentation at the Arkansas Soil and Water Education Conference at Arkansas State University, Jonesboro, AR.

January, 1998: Arkansas Soybean Meeting. Little Rock, AR.

January, 1998: Conservation Tillage Meeting. Little Rock, AR.

January, 1998: Beltwide Cotton Meeting. Orlando, FL.

August, 1998: Northeastern Research and Extension Center Field Day. Keiser, AR.

August, 1999: Rice Research and Extension Center Field Day, Certified Crop Advisor's training course. Stuttgart, AR

August, 1999: Rice Research Station Field Day. Pine Tree, AR.

August, 1999: Northeastern Research and Extension Center Field Day. Keiser, AR.

August, 1999: Annual Cotton Research and Verification Program Tour.

August, 1999: Presentation at the American Chemical Society Agricultural Symposium. New Orleans, LA.

November, 1999: S283 Precision Agriculture Project Meeting. Memphis, TN.

November, 1999: Topics in Soil and Water Conservation lecture, University of Arkansas, Fayetteville, AR.

November, 1999: Cotton Production lecture, University of Arkansas, Fayetteville, AR.

December, 1999: Presentation at the Arkansas Soil and Water Education Conference at Arkansas State University, Jonesboro, AR.

January, 2000: Presentation at the Lee County Cooperative Extension Service Cotton Production Meeting. Marianna, AR.

February, 2000: Presentation at the Arkansas Cooperative Extension Service Research Verification Seminar. Hot Springs, AR.

April, 2000: Presentation at the Arkansas Water Resource Center Annual Conference, Fayetteville, AR.

August, 2000: Northeastern Research and Extension Center Field Day. Keiser, AR.

September, 2000: Presentation at the Judd Hill Plantation Tour, Judd Hill, AR.

September, 2000: Presentation at the Cotton Research Verification Program Tour, Wilson, Marion, and Truman, AR.

November, 2000: Topics in Soil and Water Conservation lecture, University of Arkansas, Fayetteville, AR.

November, 2000: Cotton Production lecture, University of Arkansas, Fayetteville, AR.

December, 2000: Presentation at the Arkansas Soil and Water Education Conference at Arkansas State University, Jonesboro, AR.

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