

# Quantifying the Change in Greenhouse Gas Emissions due to Natural Resource Conservation Practice Application in the States of Iowa, Indiana and Nebraska

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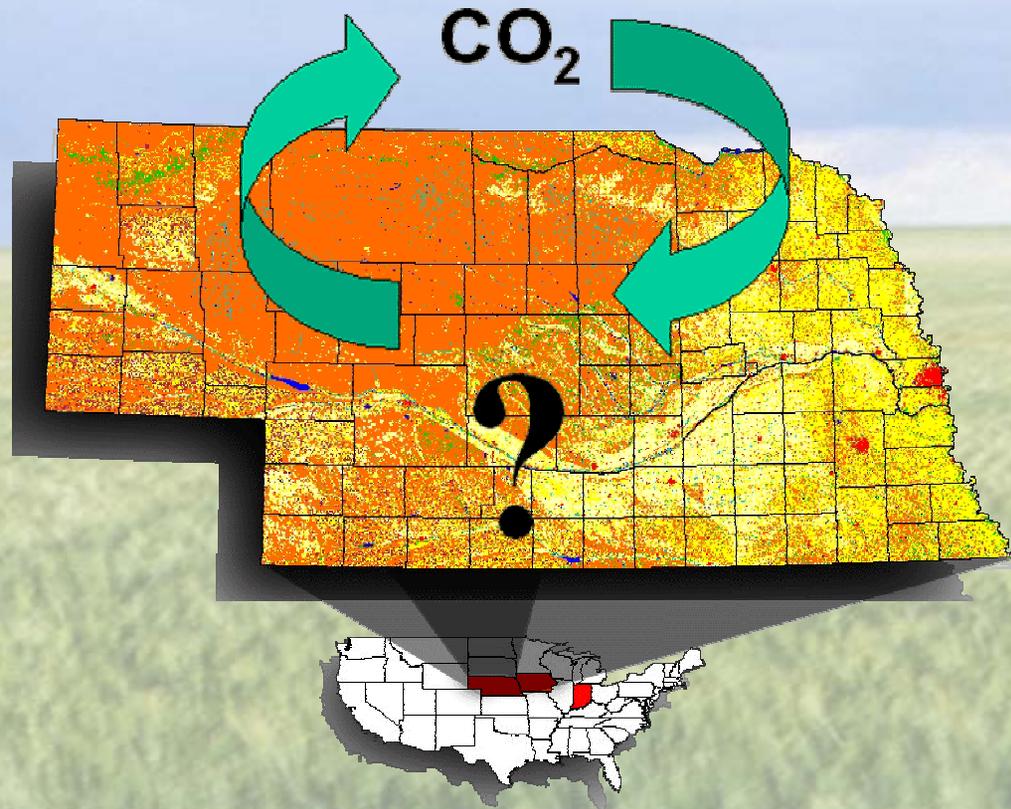
Professor Soil & Crop Science

Natural Resource Ecology Lab

Fort Collins, CO

# Objectives

- Are cropland soils in IA, IN and NE presently sequestering carbon?
- Quantify at the county level soil carbon changes due to the adoption of agricultural conservation practices.
- Local cooperation and input in the analysis.



# U.S. Potential For C Sequestration

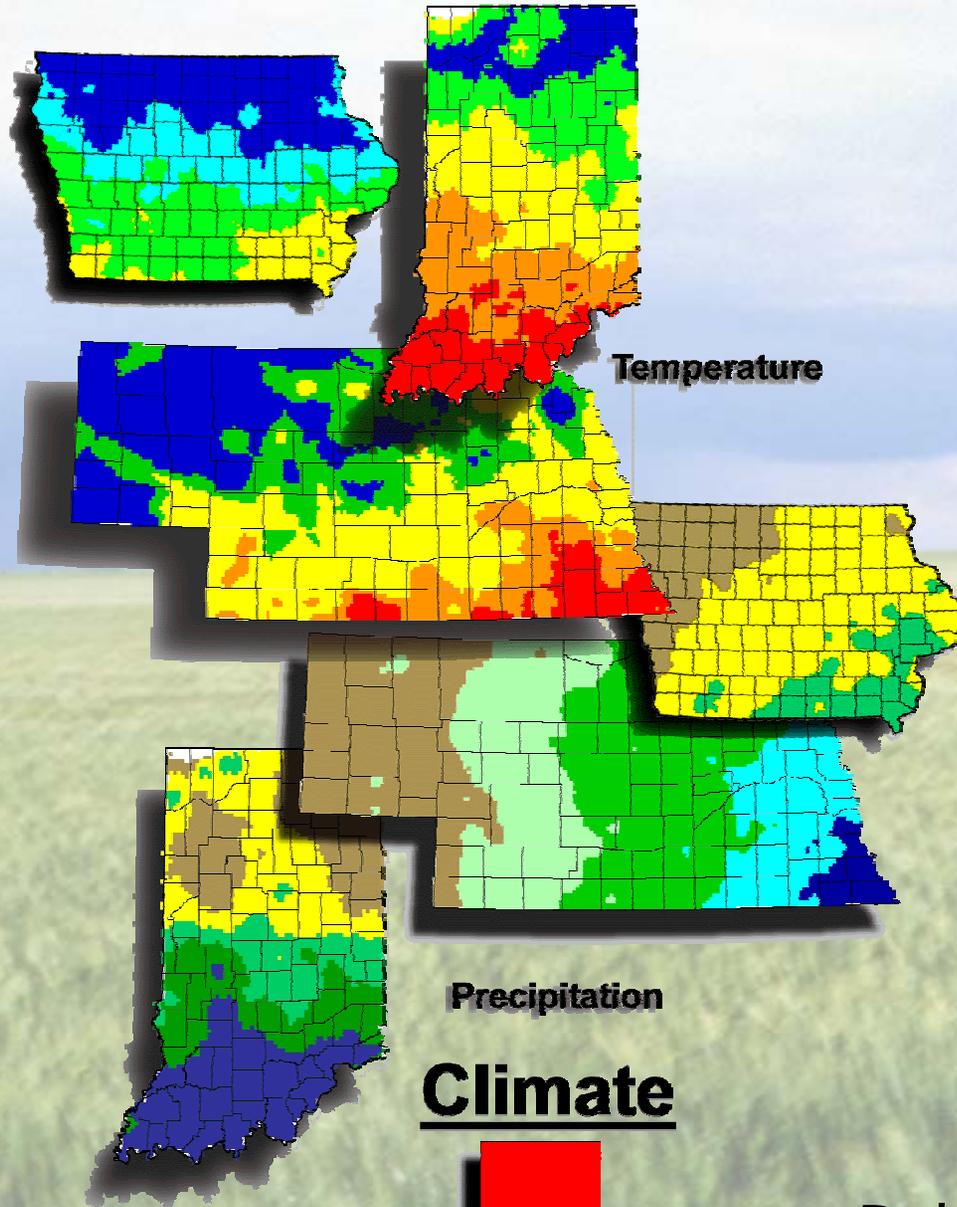
- Current net C sequestration in agricultural soils is  $\sim 20$  million tonnes per year
- Compared to  $28$  million tonnes emitted by US agriculture from fuel use, fertilizer and pesticide production
- $75 - 200$  million tonnes per year possible with present technology

Bruce et al. 1998

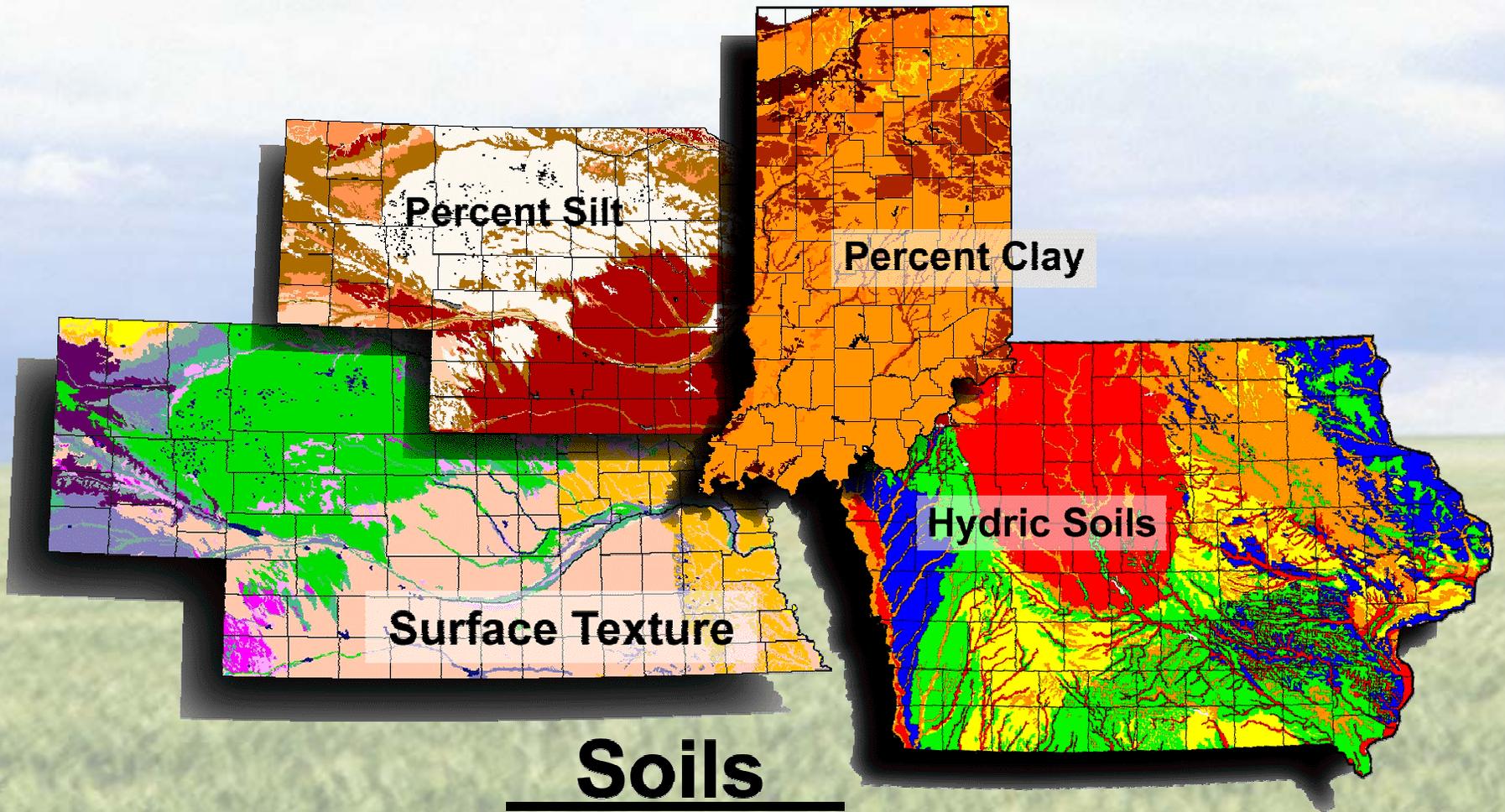
Eve et al. 2000

Lal et al. 1998





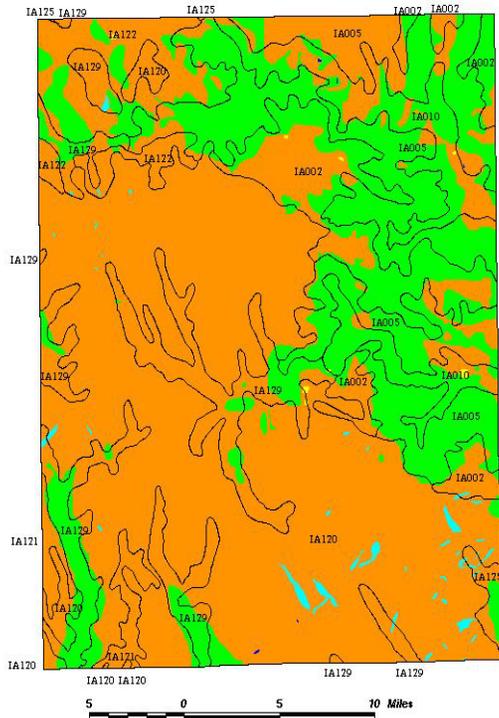
Daly et al. 1994



USDA-SCS 1994

# IA Native Vegetation, Current Land Cover and STATSGO Soil

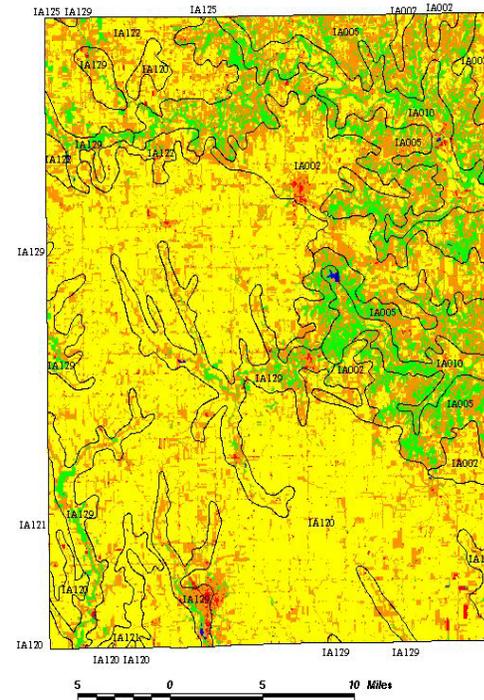
*Fayette County, Iowa - GLO (1832-1859)  
Landcover in Percent of Soil Mapunit*



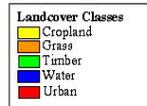
Mapunit	Landcover	Percent
IA002	Field	0
IA002	Prairie	46
IA002	Timber	53
IA002	Wetland	0
IA005	Prairie	23
IA005	Timber	76
IA010	Field	0
IA010	Prairie	32
IA010	Timber	67
IA010	Water	0
IA120	Prairie	96
IA120	Timber	2
IA120	Wetland	1
IA121	Prairie	97
IA121	Timber	2
IA122	Field	0
IA122	Prairie	74
IA122	Timber	28
IA122	Wetland	0
IA125	Prairie	63
IA125	Timber	33
IA125	Wetland	2
IA129	Field	0
IA129	Prairie	71
IA129	Timber	28
IA129	Wetland	0



*Fayette County, Iowa - GAP (1991-1992)  
Landcover in Percent of Soil Mapunit*



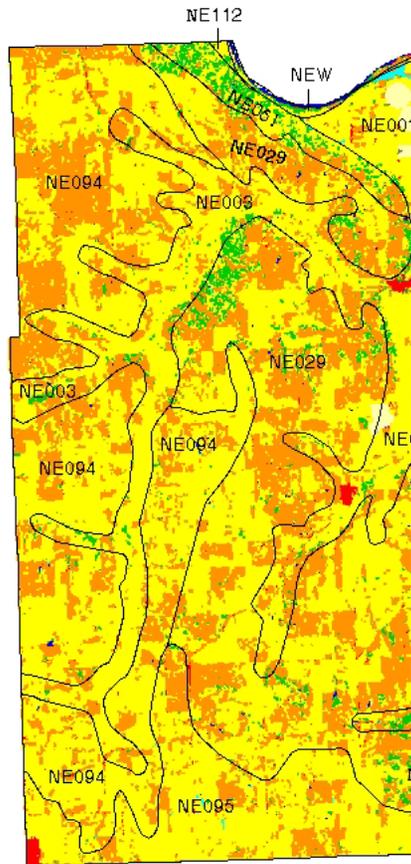
Mapunit	Landcover	Percent
IA002	Cropland	50.6
IA002	Grass	41.5
IA002	Timber	6.7
IA002	Urban	1.2
IA005	Cropland	23.6
IA005	Grass	50.6
IA005	Timber	27.4
IA005	Urban	0.4
IA005	Water	0.1
IA010	Cropland	27.3
IA010	Grass	39.5
IA010	Timber	31.7
IA010	Urban	1.4
IA010	Water	0.5
IA120	Cropland	93.1
IA120	Grass	15.3
IA120	Timber	0.7
IA120	Urban	0.9
IA121	Cropland	92.3
IA121	Grass	7.4
IA121	Timber	0.3
IA121	Urban	1.0
IA122	Cropland	59.3
IA122	Grass	34.6
IA122	Timber	5.2
IA122	Urban	0.9
IA125	Cropland	65.6
IA125	Grass	25.6
IA125	Timber	7.6
IA125	Urban	1.1
IA125	Water	0.2
IA129	Cropland	56.8
IA129	Grass	31.3
IA129	Timber	9.9
IA129	Urban	2.0
IA129	Water	0.2



IA Dept. of NR 1996  
Scott et al. 1997

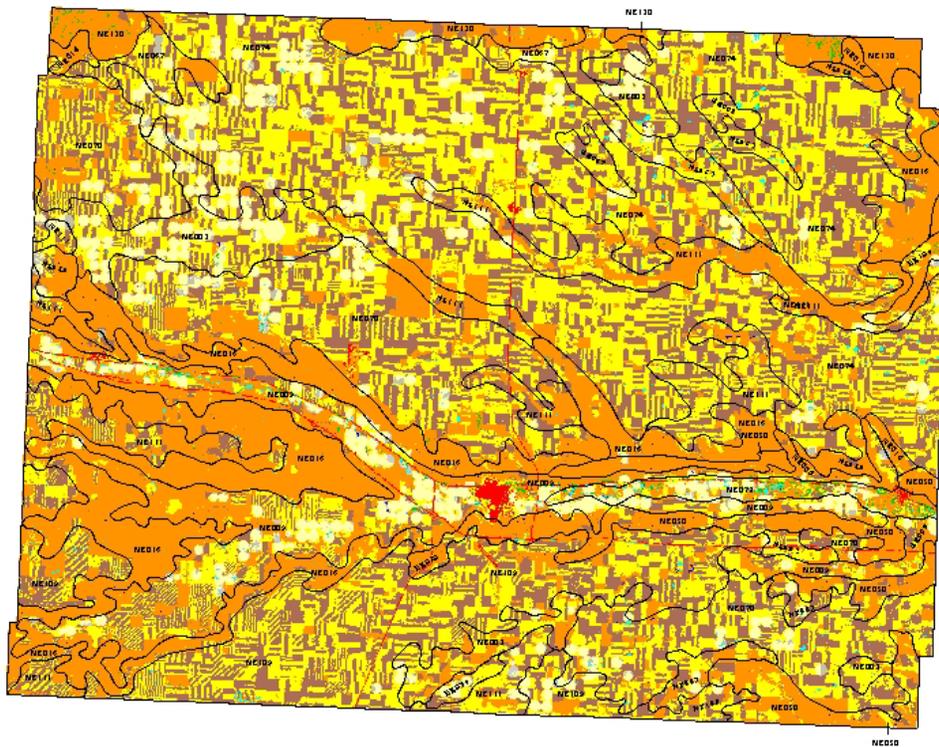
# NE Land Cover/STATSGO Soil

**DAKOTA County, Nebraska - Landuse (Circa 1993)**



SOURCE: Nebraska Carbon Sequestration Study and Colorado State University Natural Resources

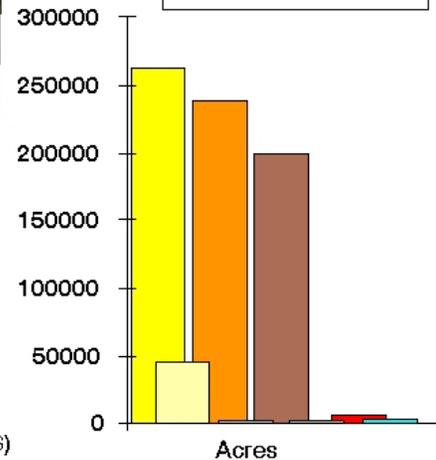
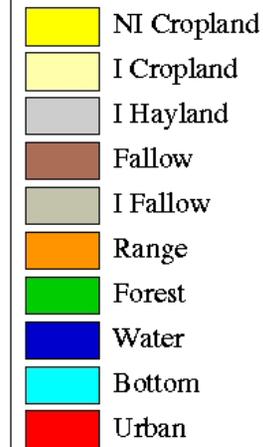
**CHEYENNE County, Nebraska - Landuse (Circa 1993)**  
**Landcover in Percent of Soil Mapunit**



10 0 10 Miles

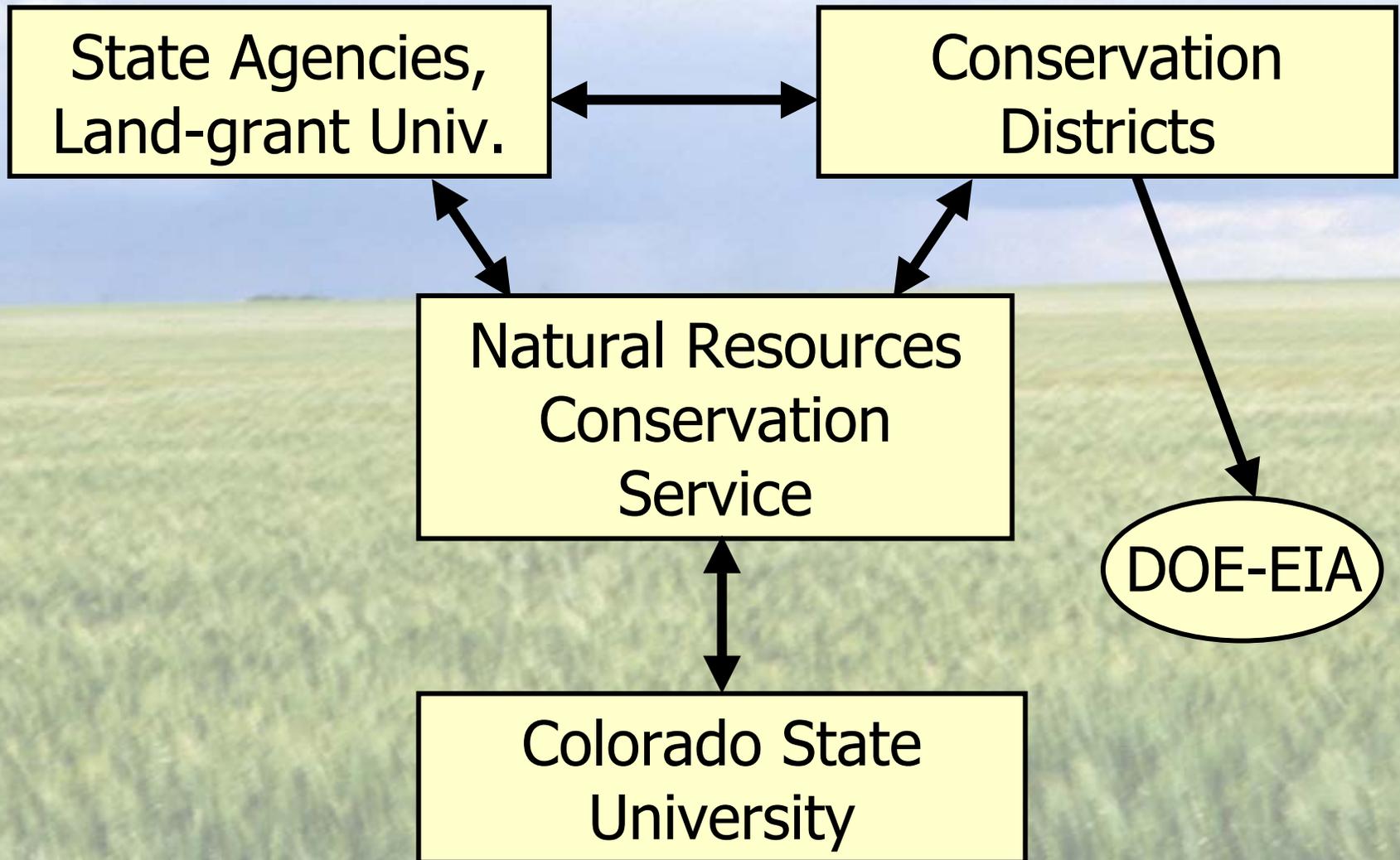
SOURCE: Nebraska Carbon Sequestration Study, USDA Natural Resources Conservation Service (NRCS) and Colorado State University Natural Resources Ecology Lab (CSU NREL), and CSU PASIS, 04/2001.

**Landcover Classes**

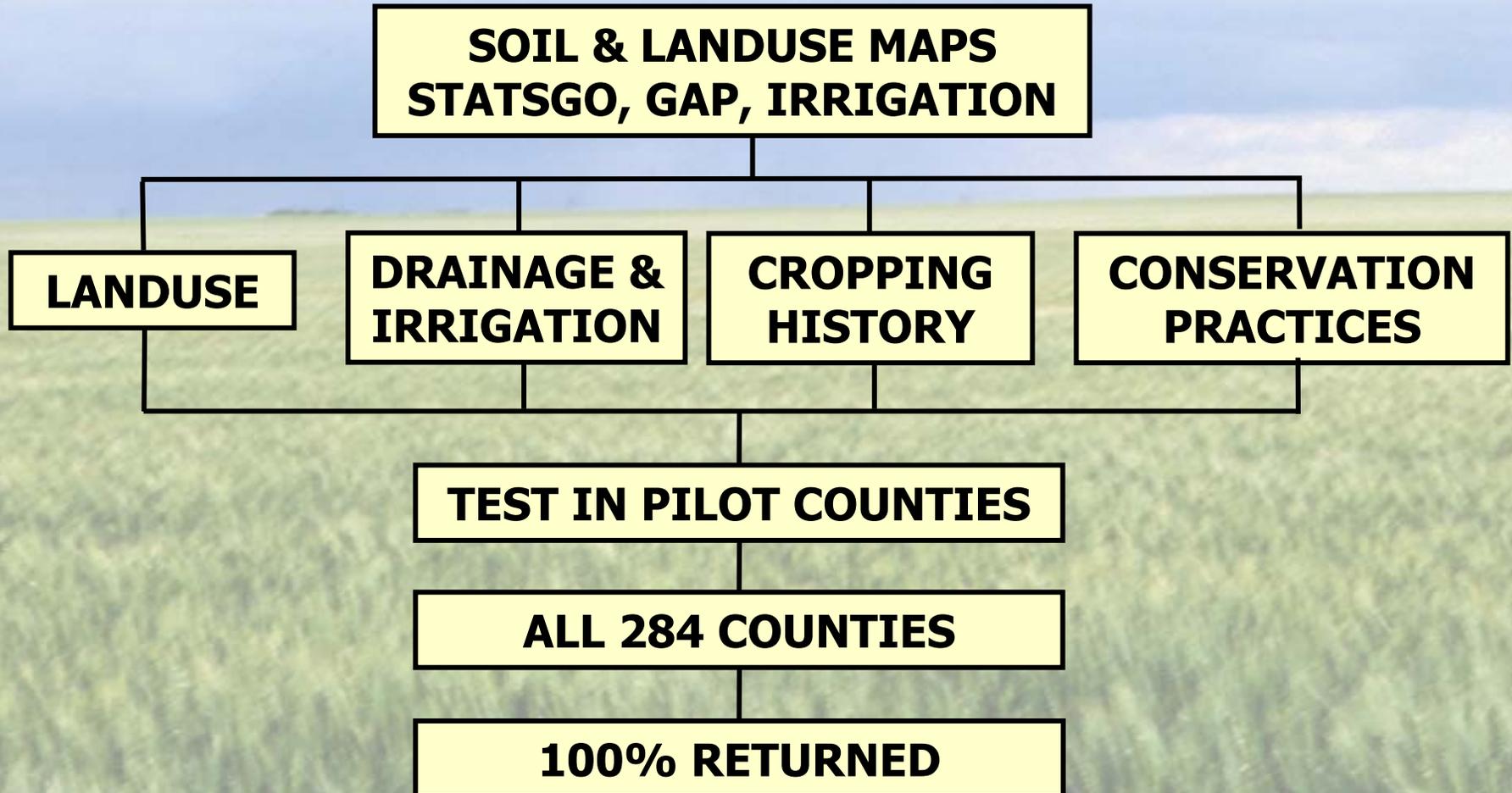


GAP 1993

# State Conservation Partners



# Carbon Sequestration Rural Appraisal (CSRA)



# Carbon Sequestration Rural Appraisal

**CARBON SEQUESTRATION RURAL APPRAISAL**

**CURRENT LAND USE INFORMATION FROM LOCAL KNOWLEDGE (Land Use)**

STATE: NEBRASKA COUNTY: ADAMS

**FOR INDICATED SOILS ON MAP DETERMINE:**

MUID (STATSGO ASSOCIATION) NE027 NE041 NE042 NE044 NE046 NE049 NE052 NE053 NE071 NETR

TOTAL ACRES IN MUID: 90,906 1,805 1,807 10,074 147,237 10,304 40,405 0,000 0,000 0,000

**LAND USE INFORMATION**

TOTAL NON IRRIGATED CROPLAND: GENERAL LAND USE INFORMATION FROM LOCAL KNOWLEDGE (Drain)

CLASS I & II CLASS III & IV CLASS V & VI

Non Irrigated Cropland Sub Total: HAS ANY PART OF THE COUNTY BEEN DRAINED (YES/NO) Yes

TOTAL IRRIGATED CROPLAND: GENERAL LAND USE INFORMATION FROM LOCAL KNOWLEDGE (Irrigation)

CLASS I & II CLASS III & IV CLASS V & VI

Irrigated Cropland Sub Total: IS 5% OR MORE OF ANY MUID IRRIGATED (YES/NO) Yes

FALLOW AGRICULTURAL FIELD: NE027 1,159

TOTAL RANGE: NE041 1,172

EXCELLENT: NE042 48

GOOD: NE044 1,863

FAIR: NE046 1,476

POOR: NE049 0

Range Sub Total: NE052 0

FOREST: NE053 396

URBAN / OTHER: NE071 0

BOTTOMLAND: NET16 0

WATER TOTAL: NE046

PERCENT OF COUNTY FARMED IN FOLLO

**ANNUAL CONSERVATION PRACTICES INSTALLED**

CONSERVATION PRACTICES INSTALLED BY COUNTY AND SOIL MAP UNIT

CROP ROTATIONS (SPECIFY 1 TO 4) USE IN REPORTING TO DDE FOR CARBON SEQUESTRATION (USE SEPARATE SHEET FOR EACH SOIL MUID)

ROTATION 1: CORN (I)

ROTATION 2: MILO

ROTATION 3: WHEAT (D)

ROTATION 4: CORN (D)

**ACRES OF CONSERVATION PRACTICES INSTALLED (ACRES)**

MUID	COUNTY	TOTAL ACRES	TOTAL CROP LAND	NON IRRIGATED CROPLAND	IRRIGATED CROPLAND	FALLOW
		28,386	24,818	6,632	18,086	38
PERCENT		8.2%	7.3%	8.8%	12%	

**LANDSCAPE DESCRIPTION**

FLAT (<2% SLOPE)

ROLLING HILLS (2-6% SLOPE)

STEEP HILLS (>6% SLOPE)

TOTAL

**TOTAL NON IRRIGATED CROPLAND**

CLASS I & II: % OF THIS SO

CLASS III & IV: % OF THIS SO

CLASS V & VI: % OF THIS SO

BOTTOMLAND: % OF THIS SO

FOREST: % OF THIS SO

RANGE: % OF THIS SO

**IRRIGATED ACRES IN MAP UNIT:** ENTER TOTAL ACRES IRRIGATED ANNUAL AMOUNT APPLIED (MCI)

PREDOMINATE SYSTEM TYPE: E/ CROP NAME

WATER SOURCE: PULL DOWN/MENU

AVERAGE PUMPING DEPTH FT.:

**YIELD (BU OR TONS OR LBS.)**

Year	CSRA CROP ACRES IN COUNTY	NASS CROP ACRES IN COUNTY	Yield
1985	13	13	1,985
1986	13	13	1,987
1987	13	13	1,988
1988	13	13	1,989
1989	13	13	1,990
1990	13	13	1,991
1991	13	13	1,992
1992	13	13	1,993
1993	13	13	1,994
1994	13	13	1,995
1995	13	13	1,996
1996	13	13	1,997
1997	13	13	1,998
1998	13	13	1,999
1999	13	13	2,000
2000	13	13	2,001
Current Total	13	13	12,850

**MANURE** Season Predominate Type AS APPLIED (TONS/AC)

Land use

Drainage

Irrigation

Crop Mgmt.

Conservation Practices

**ALL VALUES FOR 1985** ARE TOTAL ACRES FOR ALL ACTUAL PRACTICES APPLIED IN THE FIELD IN 1985.

**ALL VALUES FOR 1986 - 2000** ARE ACRE CHANGES FROM THE PREVIOUS YEAR. NO TILL AND MODERATE TILL VALUES CAN BE POSITIVE OR NEGATIVE.

**MUID:** SOIL MAP UNIT ID FROM STATSGO. (FROM MAP)

**NO-TILL:** NO-TILL FARMING SYSTEM THROUGHOUT THE ENTIRE ROTATION WITH NO DISTURBANCE OF THE SOIL SURFACE OTHER THAN OPERATIONS FOR INJECTION OF NITROGEN AND PLANTING OF CROPS.

**MODERATE TILLAGE:** MEAN ANNUAL RESIDUE COVER FOR THE ENTIRE ROTATION > 15% AT PLANTING IT IS THE CROP ROTATION SYSTEM THAT IS BEING EVALUATED, NOT A SINGLE YEAR. EXAMPLE: A WHEAT/FALLOW ROTATION THAT HAS 95% RESIDUE COVER AT WHEAT PLANTING IS MODERATE TILLAGE. A CORN-SOYBEAN ROTATION WITH 10% COVER AT CORN PLANTING AND 40% AT SOYBEAN PLANTING AVERAGES 26% THIS IS MODERATE TILLAGE.

**CRP:** ALL GRASS PLANTINGS, WOODLAND PLANTINGS, AND WETLANDS CREATED UNDER CRP CONTRACT. ALSO INCLUDE CRP CONTRACT LAND THAT REVERTED BACK TO CROPLAND AND INCLUDE ALL LAND USE CHANGE FROM CROPLAND TO DESIGNATED LAND USE, AND LAND CHANGED BACK INTO CROPLAND.

# Data Sources and Quality Control

NASS Database

CTIC Database

Analysis

Database

USDA-NASS Nebraska Agricultural Statistics Service - Netscape

NEBRASKA AGRICULTURAL STATISTICS SERVICE

1990 Summaries

County: Nebraska Adams 1990

Conservation Tillage: Total Tillage, No-Till, Ridge-Till, Mulch-Till

Other Tillage Systems: 15 - 30% Residue (Reduced Tillage), 0 - 15% Residue (Conventional Till)

MS Sans Serif 13.5

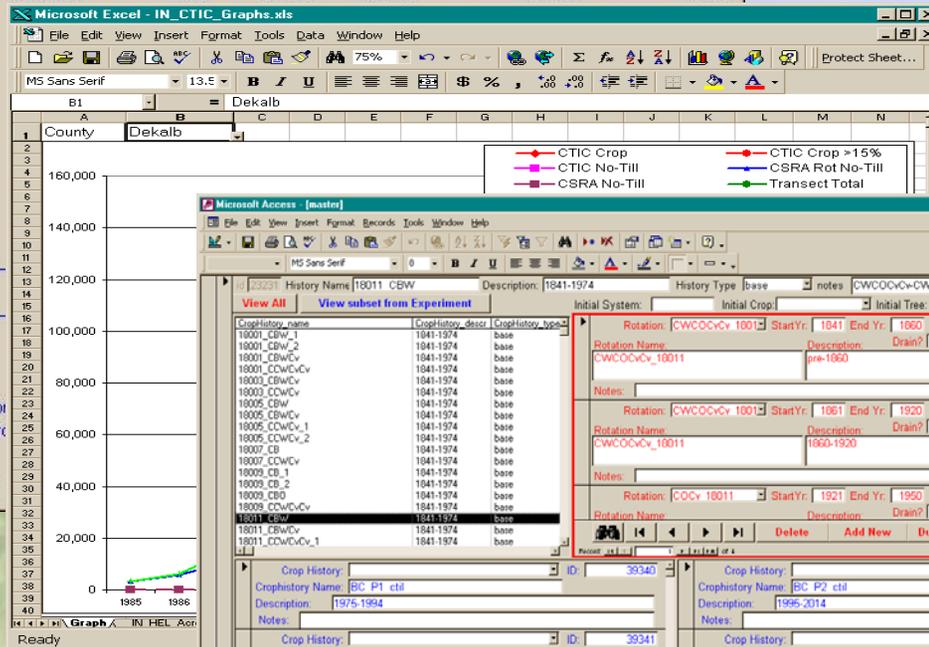
MS Excel - IN\_CTIC\_Graphs.xls

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Microsoft Access [master]

History Name: 18011 CBW Description: 1841-1974 History Type: lbase notes: CWCC0Cv-CWCC0Cv-C00C-CW0Cv

CropHistory_name	CropHistory_desc	CropHistory_type
18001_CBW_1	1841-1974	base
18001_CBW_2	1841-1974	base
18001_CBW_Cv	1841-1974	base
18001_CDWCv	1841-1974	base
18003_CBW_Cv	1841-1974	base
18003_CDWCv	1841-1974	base
18005_CBW	1841-1974	base
18005_CBW_Cv	1841-1974	base
18005_CDWCv_1	1841-1974	base
18005_CDWCv_2	1841-1974	base
18007_CB	1841-1974	base
18007_CDWCv	1841-1974	base
18009_CB_1	1841-1974	base
18009_CB_2	1841-1974	base
18009_CBO	1841-1974	base
18009_CDWCv	1841-1974	base
18011_CBW_Cv	1841-1974	base
18011_CDWCv_1	1841-1974	base



Microsoft Access [master]

View All View subset from Experiment

CropHistory_name	CropHistory_desc	CropHistory_type
18001_CBW_1	1841-1974	base
18001_CBW_2	1841-1974	base
18001_CBW_Cv	1841-1974	base
18001_CDWCv	1841-1974	base
18003_CBW_Cv	1841-1974	base
18003_CDWCv	1841-1974	base
18005_CBW	1841-1974	base
18005_CBW_Cv	1841-1974	base
18005_CDWCv_1	1841-1974	base
18005_CDWCv_2	1841-1974	base
18007_CB	1841-1974	base
18007_CDWCv	1841-1974	base
18009_CB_1	1841-1974	base
18009_CB_2	1841-1974	base
18009_CBO	1841-1974	base
18009_CDWCv	1841-1974	base
18011_CBW_Cv	1841-1974	base
18011_CDWCv_1	1841-1974	base

Rotation: CWCC0Cv\_18011 StartYr: 1841 End Yr: 1950 Inq?: Drain? Degree (0-1.0): pre-1850

Rotation: CWCC0Cv\_18011 StartYr: 1861 End Yr: 1920 Inq?: Drain? Degree (0-1.0): 1860-1920

Rotation: C0Cv\_18011 StartYr: 1921 End Yr: 1950 Inq?: Drain? Degree (0-1.0):

Climate



Soils



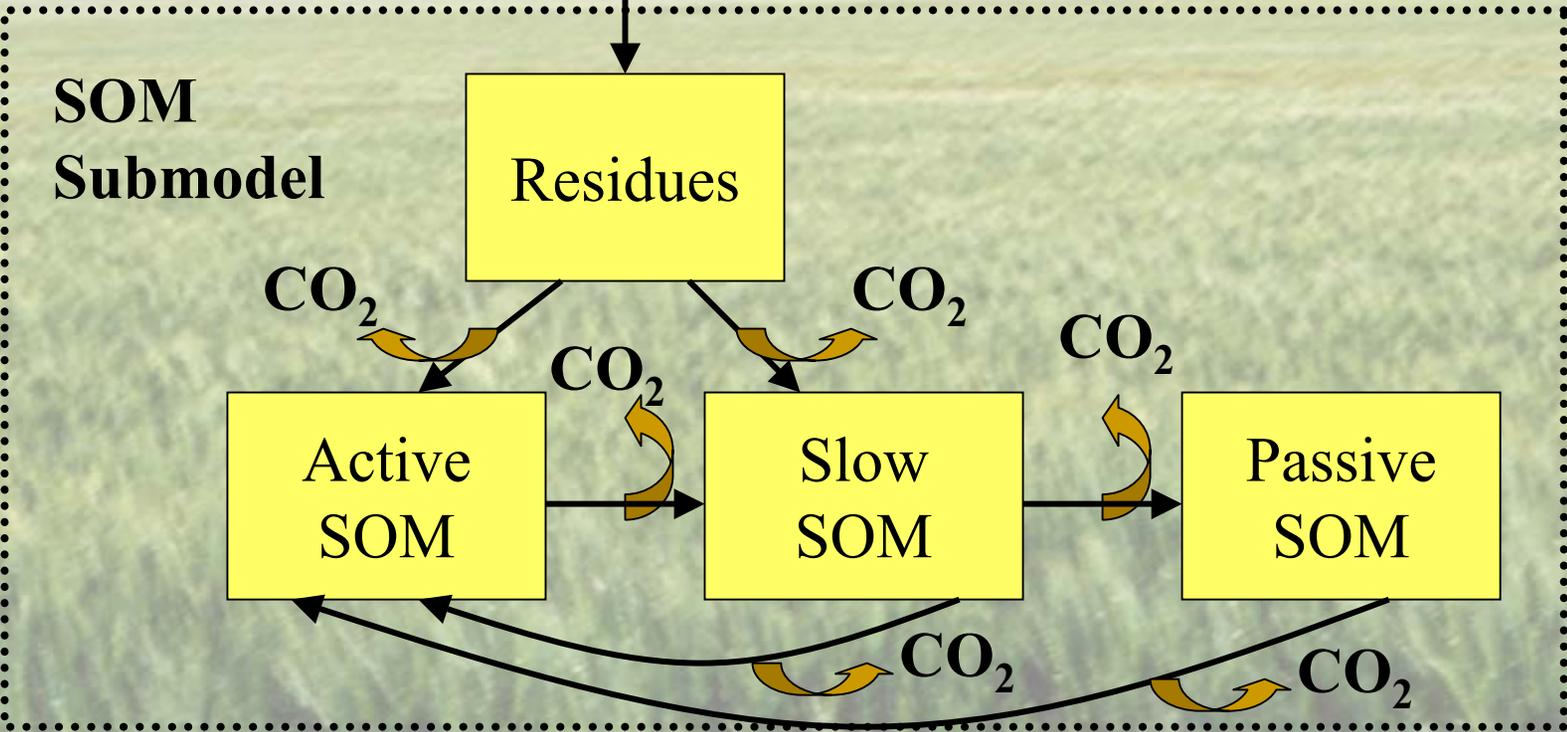
Management



*Century model*

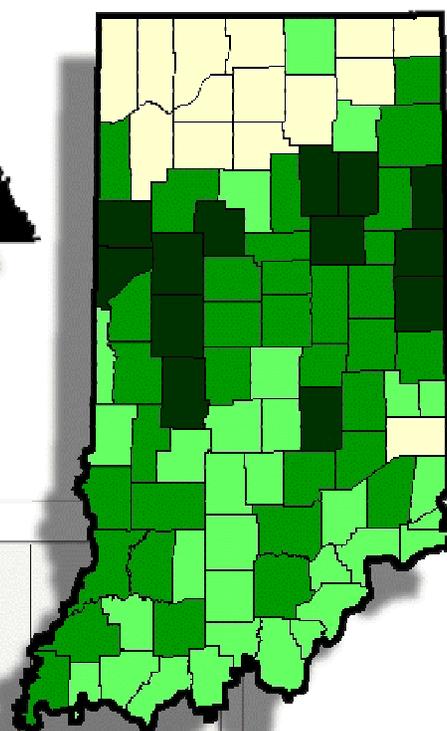
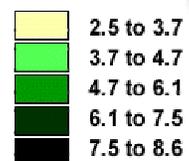
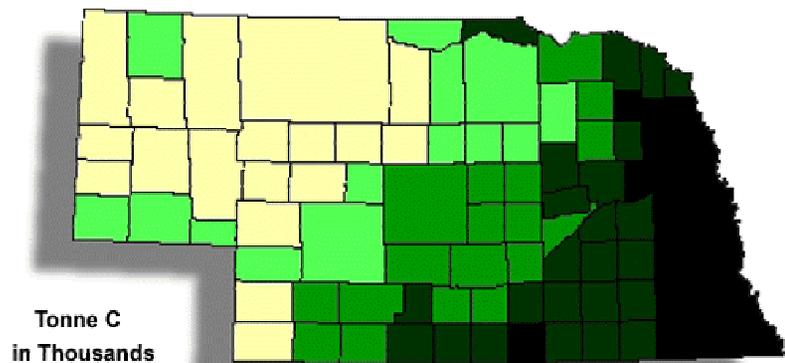
Plant  
Growth  
Submodel

Water  
Balance  
Submodel



# Current Rates of soil C change (MMT C)

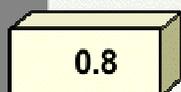
Practice	Nebraska		Iowa		Indiana	
	Mha	TgC	Mha	TgC	Mha	TgC
Conventional Tillage	3.6	0.24	5.2	0.43	2.7	0.25
Mulch Tillage	4.2	0.59	3.0	0.82	2.1	0.79
No Tillage	0.4	0.20	1.1	0.66	0.4	0.19
CRP/grass	0.4	0.25	1.1	1.34	0.2	0.22
Tree/wetland	0.02	0.01	0.06	0.03	0.02	0.01
Cult. of organic soil	na	na	0.022	-0.17	0.086	-0.68
<b>Net change</b>		<b>1.3</b>		<b>3.1</b>		<b>0.8</b>



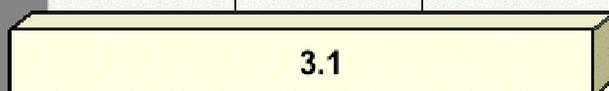
Nebraska  
Year 2000



Indiana  
Year 1999

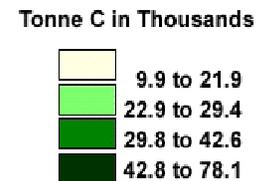
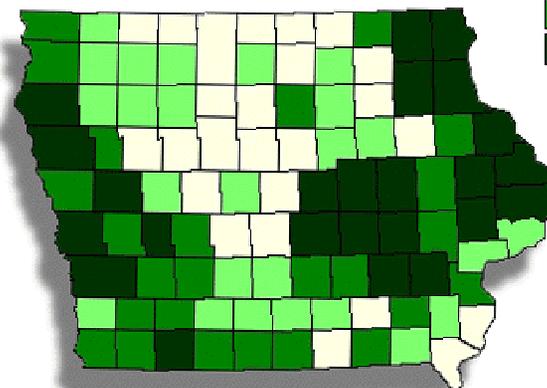


Iowa  
Year 1998



0 1 2 3 4

Carbon Sequestered (MMTCE)



Microsoft Access - [master]

File Edit View Insert Format Records Tools Window Help

MS Sans Serif

History Name: 18011 CBW Description: 1841-1974

Initial System: Initial Crop: Initial Tree:

CropHistory_name	CropHistory_descr	CropHistory_type
18001_CBW_1	1841-1974	base
18001_CBW_2	1841-1974	base
18001_CBW_Cv	1841-1974	base
18001_CW_Cv_Cv	1841-1974	base
18002_CBW_Cv	1841-1974	base
18002_CW_Cv	1841-1974	base
18005_CBW	1841-1974	base
18005_CBW_Cv	1841-1974	base
18005_CW_Cv_1	1841-1974	base
18005_CW_Cv_2	1841-1974	base
18007_CB	1841-1974	base
18007_CW_Cv	1841-1974	base
18009_CB_1	1841-1974	base
18009_CB_2	1841-1974	base
18009_CBD	1841-1974	base
18009_CW_Cv_Cv	1841-1974	base
18011_CBW	1841-1974	base
18011_CBW_Cv	1841-1974	base
18011_CW_Cv_Cv_1	1841-1974	base

Rotation: CWCOcVcV\_18011 StartYr: 1841 End Yr: 1860 Irrig? Drain? Degree (0-1.0):

Rotation Name: CWCOcVcV\_18011 Description: pre-1860

Notes:

Rotation: CWCOcVcV\_18011 StartYr: 1861 End Yr: 1920 Irrig? Drain? Degree (0-1.0):

Rotation Name: CWCOcVcV\_18011 Description: 1860-1920

Notes:

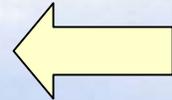
Rotation: COcV\_18011 StartYr: 1921 End Yr: 1950 Irrig? Drain? Degree (0-1.0):

Rotation Name: Description: Drain? Degree (0-1.0):

Notes:

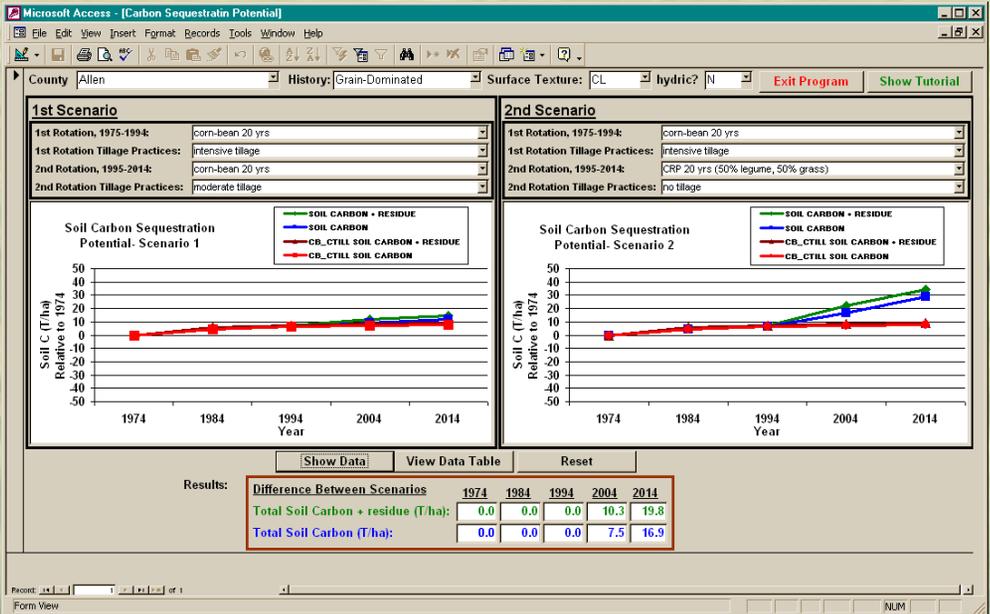
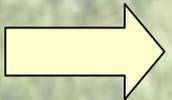
Records: 1 of 47

Form View



# Databases of Conservation Practices

# Decision Support Models



# Conclusions

- Are cropland soils in IA, IN and NE presently sequestering carbon? (**YES**)
  - 5.2 MMT C currently.
- Quantify at the county level soil carbon changes due to the adoption of agricultural conservation practices. (**YES**)
  - Have county specific decision support models to access the soil C changes when applying conservation practices.
  - Analysis is detailed enough to allow local land managers to make C sequestration related decisions based on local soils and land use conditions.
- Local cooperation and input in the analysis. (**YES**)
  - 100% participation of the conservation districts and natural resource districts in all 284 counties.
  - State conservation partners are willing to take leadership roles to increase the awareness of C sequestration issues.
  - States are reporting sequestered C to DOE-EIA.