Impacts of implemented BMPs on Runoff and Pollutant Loading From Field Scale Watersheds

PIs:

D. Ginting, M. Mamo, and C. Wortmann

Dep. Agronomy and Horticulture, UNL

G. Helmers, Dep. Agr. Economics, UNL

Collaborators:

Paul Brakhage: NDEQ
James Harder and, Dennis Schroeder : NRCS
Paul Zillig; Lower Platte South NRD

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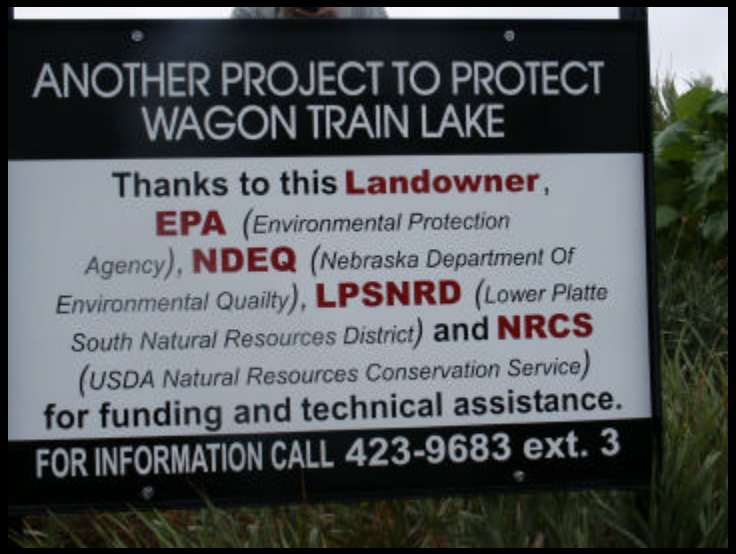
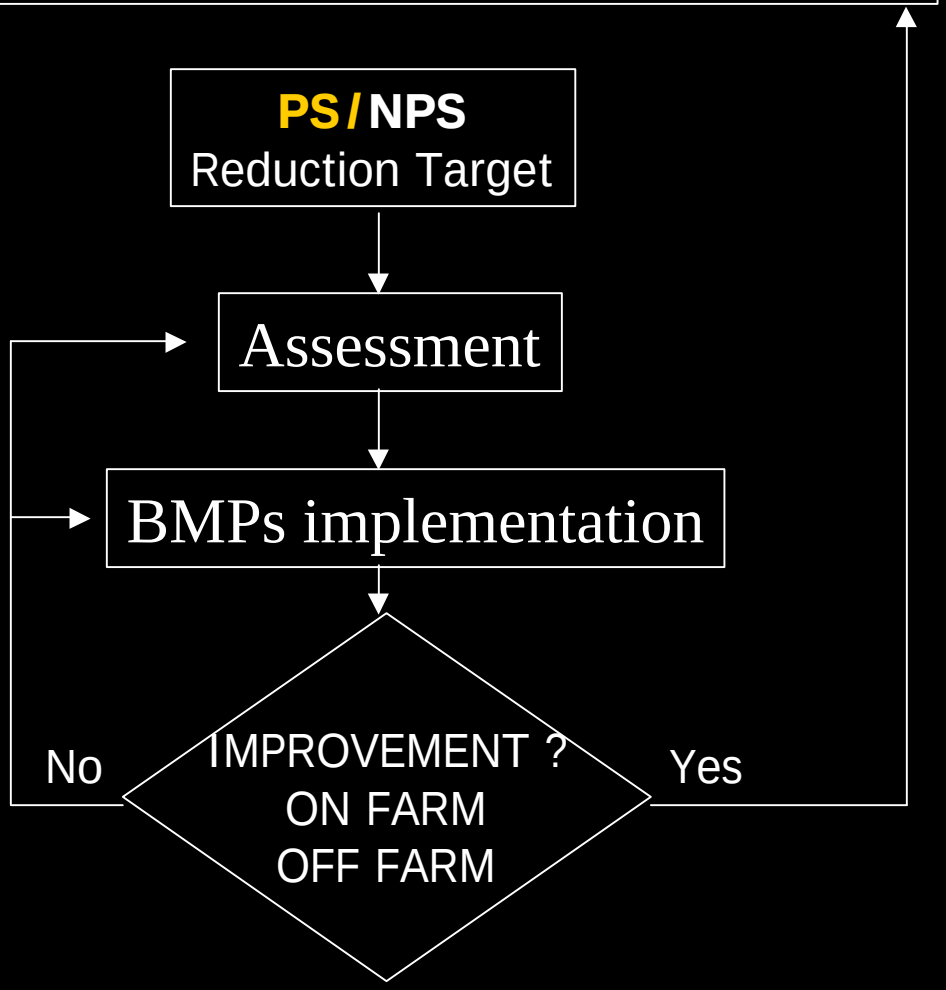
INTRODUCTION

- Nebraska's 303(d) list of impaired waters

WATERQUALITY IMPROVEMENT AND REMOVAL FROM LIST

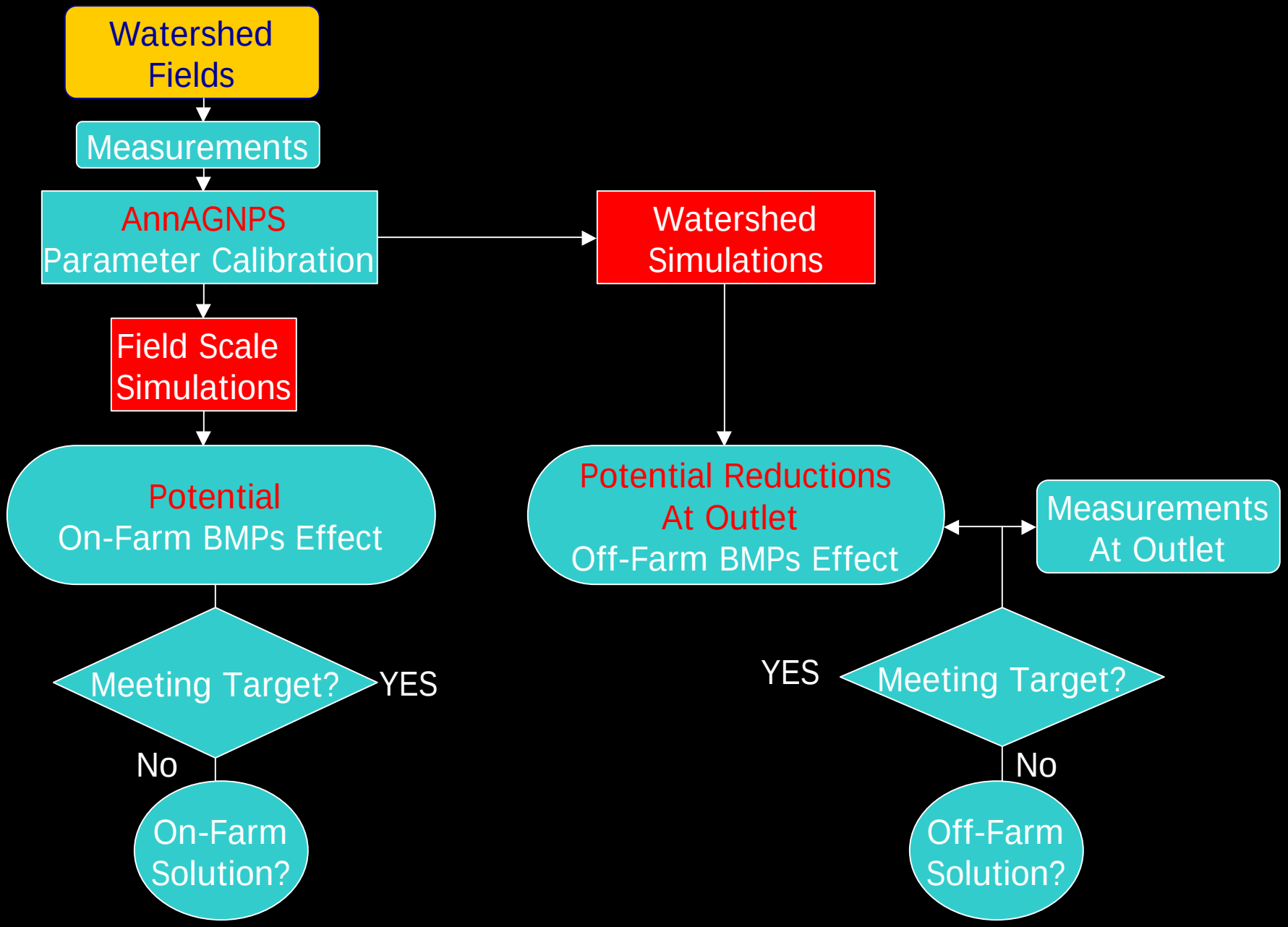




OBJECTIVES

To evaluate the on-farm and off-farm effects of implemented BMPs (no-till and no-till plus terraces) on runoff pollutant loads.

MATERIALS AND METHODS



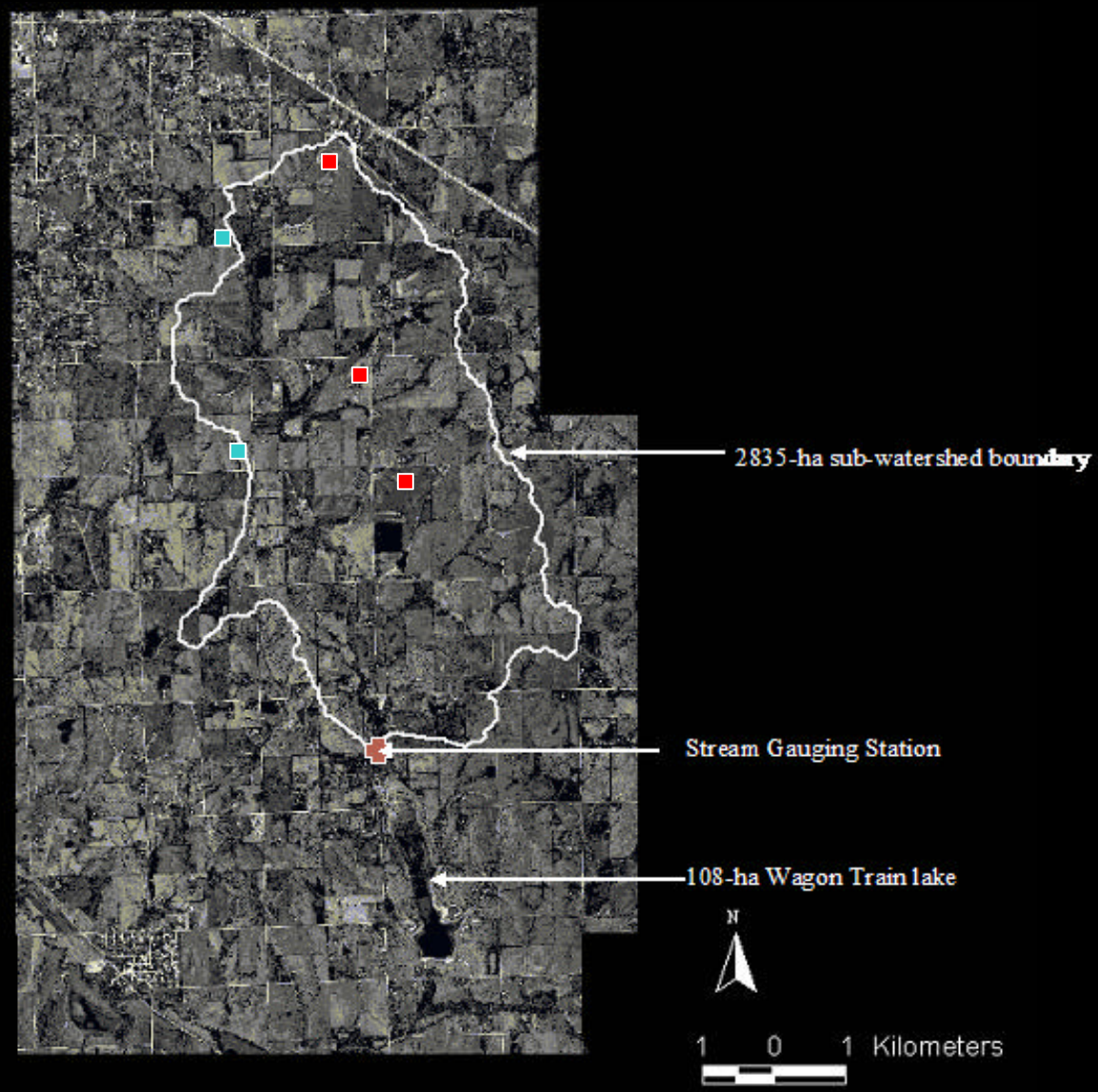
MATERIALS AND METHODS

USCAE LAKE SURVEY
Sediment Entered Lake
1.3 Mg ha^{-1} yr^{-1} (1968-1987)
3.2 Mg ha^{-1} yr^{-1} (1987-1996)

75% reduction, Target Load
0.6 Mg ha^{-1} yr^{-1}

One Stream Monitoring at upper end of Wagon Train Lake since Nov. 2003

Five field scale watersheds (since May 2004)



Three field scale watersheds were :

1. Conventional tillage (CL) system on non-terraced (NT) field, identified as CL-NT.

2. No Tillage (NL) system on non-terraced (NT) field, identified as NL-NT.

3. No Tillage (NL) on terraced (T) field, identified as NL-T field.

Presence of ephemeral gully in CL-NT and NL-NT

All fields have similar soil and fertility level

Measurements:

Rainfall

Runoff

Sediment

N, P

Topography (5m x 5 m DEM)

AnnAGNPS Parameter Calibration

CELLS AND REACHES: 5 m x 5 m DEM, 30m x 30m DEM

CROP DATA: RUSLE crop database.
Modification: N and P uptake, C/N and C/P

SOIL DATA: SSURGO Database
Modification: Surface N,P,OM

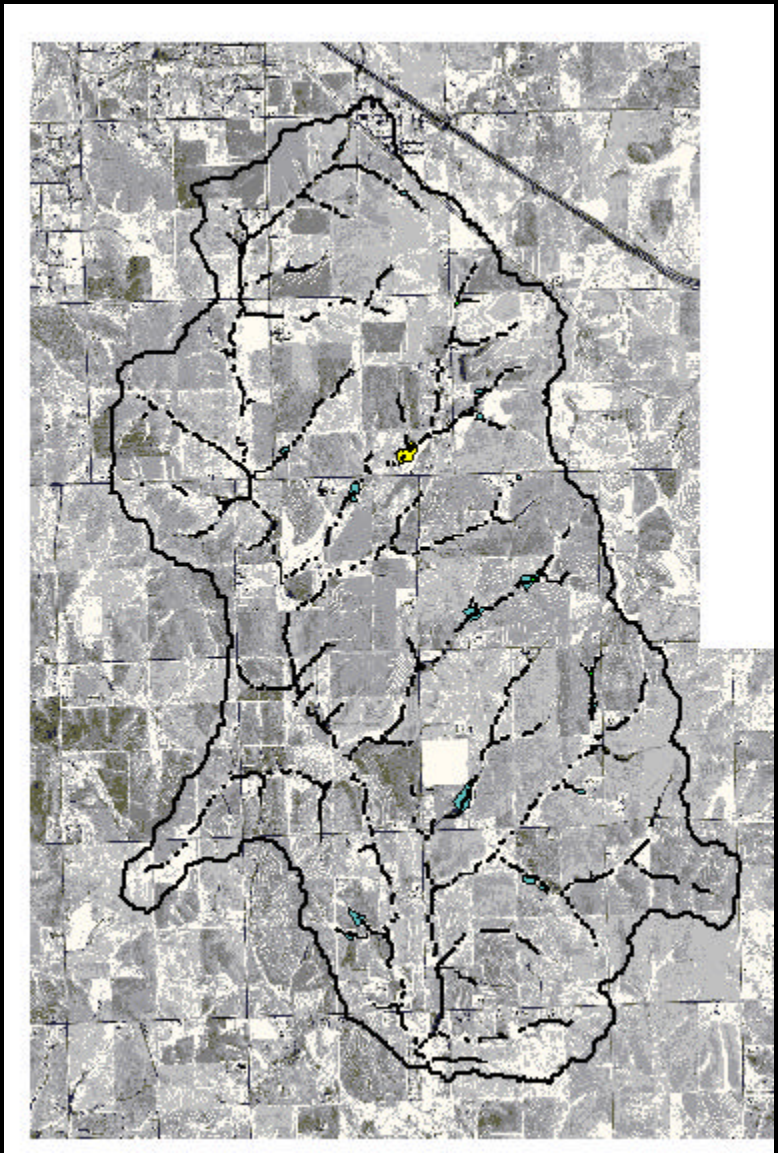
CLIMATIC DATA: Daily weather data (1986-2005)

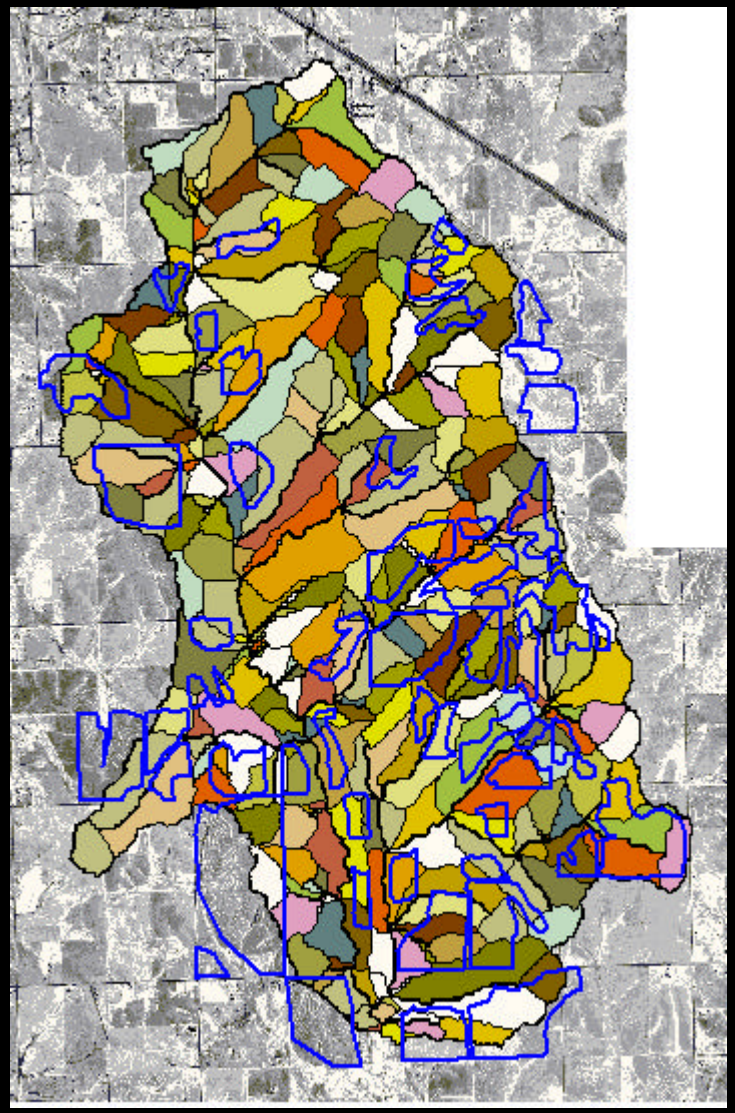
RUNOFF CN: Mar.-May, June, July-February
rainfall pattern and crop growth

EPHEMERAL GULLY: Measured Sediment-sheet And Rill

Long Term BMPs Performance Off-Farm:

30 m x 30 m DEM, CSA=10 ha, Digitized Terraces (25% area), Digitized Impoundments, NASS





Potential Sediment Reduction Off-Farm

Current practice:

Non-terraced cells (75% area) are set to be no-till system and have ephemeral gullies. The terraced cells (25% area) are set to be in no-till, and no longer-gullied.

Proposed Practice:

1. Effects of gully: eliminate gullies in the non-terraced cells without terracing.
2. Effects of terraces: all cells are terraced.

RESULTS AND DISCUSSION

Rain > 40 mm or sediment loss > 0.1 Mg ha^{-1}

	NL-NT			CL-NT		
Date	rainfall	runoff	sediment	rainfall	runoff	sediment
	--------mm-----		Kg ha^{-1}	----mm--------		Kg ha^{-1}
5/18/2004	18.8	1.5	130	22.9	1.1	27.1
5/22/2004	63.5	44.3	7557	54.4	44.6	11247
5/30/2004	16.8	0.4	103	14.0	0.6	90.0
6/12/2004	37.3	1.9	332	31.8	0.6	74.2
5/12/2005	19.6	5.4	427	24.9	0.9	25.0
7/25/2005	60.5	0.0	0	61.5	0.0	0.0

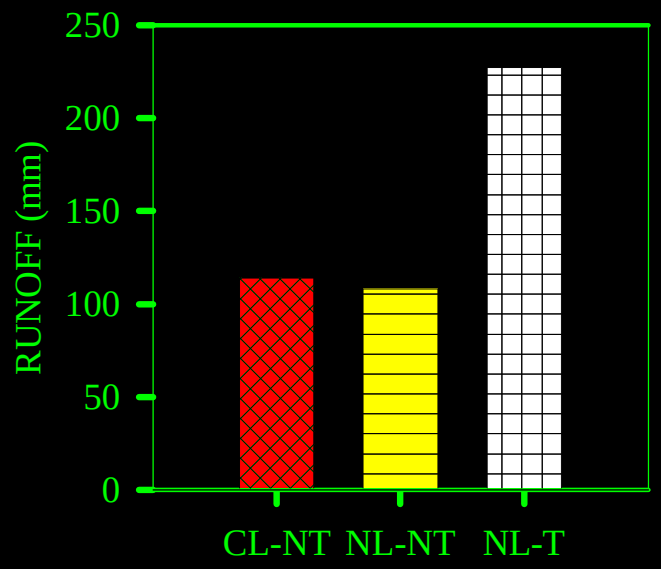
Field vs. Watershed, 2004

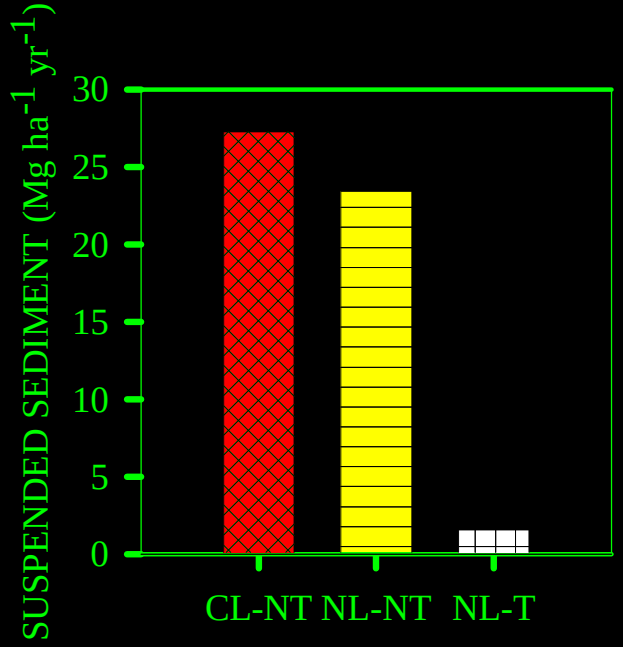
		May	June	July	Total
Runoff (mm)	NL-NT	46.5	2.45	1.15	50.1
	CL-NT	46.2	1.09	0.45	47.7
	NL-T	-	-	27.8	-
	Watershed	39.1	7.65	3.93	50.6
Sediment ($kg\ ha^{-1}$)	NL-NT	7817	407	150	8375
	CL-NT	11364	142	71	11579
	NL-T	-	-	117	-
	Watershed	460	189	25	674

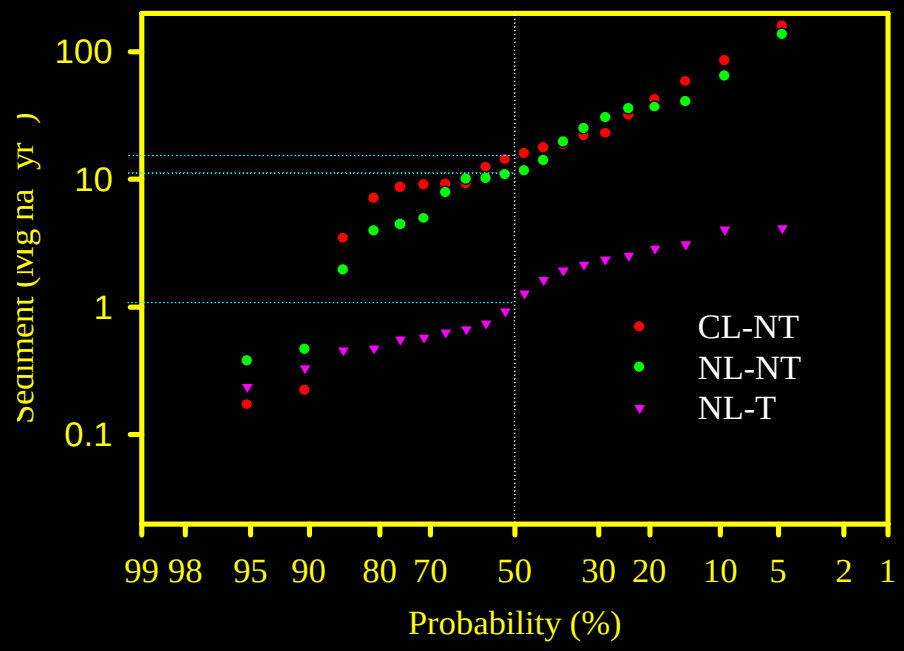
Field vs. Watershed, 2005

		May	June	July	Total
Runoff	NL-NT	5.40	0.42	0.00	5.81
(mm)	CL-NT	0.89	1.59	0.00	2.48
	NL-T	-	2.14	0.76	-
	Watershed	1.27	0.57	0.00	1.83
Sediment	NL-NT	427	6.46	0.0	433
(kg ha^{-1})	CL-NT	72	31	0.0	103
	NL-T	-	1.2	0.4	-
	Watershed	5.4	0.9	0.00	6.3

20-yr simulation







Year	Feb.	Mar.	Apr.	May	June	ANNUAL
	---------- kg ha^{-1}----------					
2004	109	912	56	460	189	1769
2005	4	1	3	5	1	14

Simulated Sediment reduction Potential

Elimination of Gully : 0.4%
Terracing : 1.5%

Need further sediment load reduction: STREAM BANKS?

CONCLUSIONS

No-till system reduced sediment and nutrient losses from fields during intense rainfall.

Ephemeral gully erosion caused excessive sediment yield from fields managed with no-till or conventional till. Elimination of gully erosion by terracing was effective for reduction of sediment yields from fields.

Reduction of on-farm sediment yield by elimination of gully and/or terracing could not meet the sediment reduction target off-farm. Off-farm mitigation of sediment losses due to other processes e.g. Stream Bank erosion is necessary.