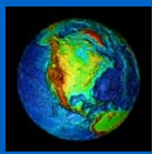
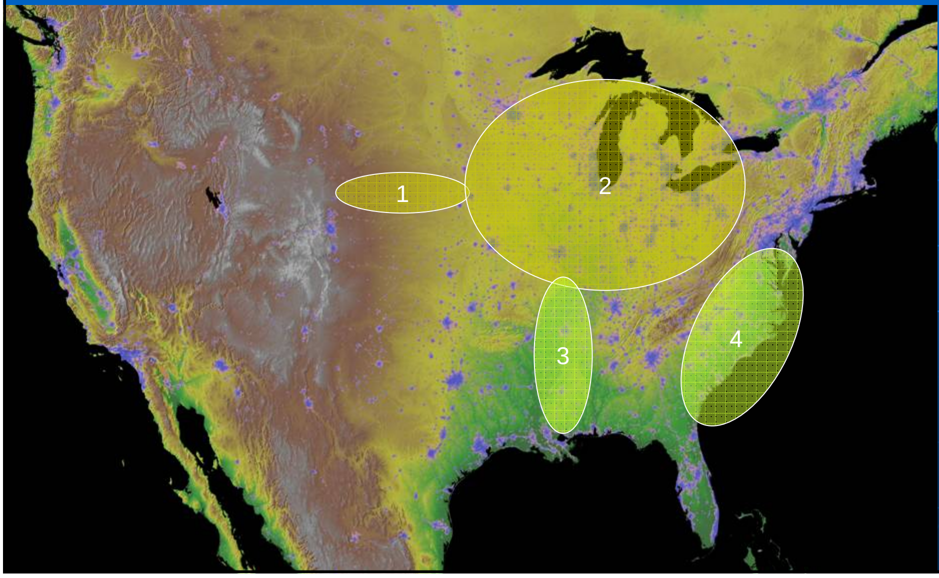


Improving Water Use Efficiency in Agriculture

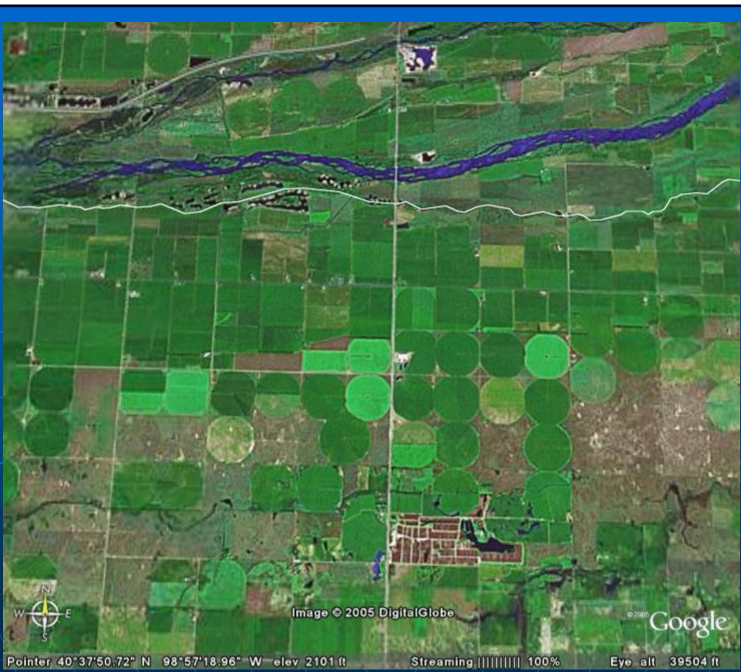
E. J. Sadler – USDA-ARS Columbia MO
W. C. Bausch – USDA-ARS Ft Collins CO
N. R. Fausey – USDA-ARS Columbus OH
R. B. Ferguson – University of Nebraska, Lincoln NE

Optimizing Resource Use Efficiency for Sustainable Intensification of Agriculture
Kunming, China, 27 February – 2 March 2006

Four Case Studies



Case 1 - Platte River Valley



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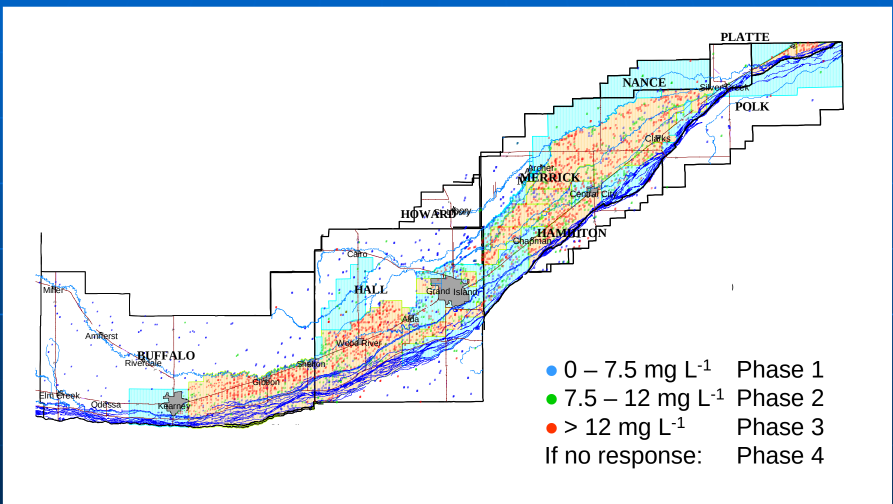
Central Platte Natural Resources District Groundwater Management Area (GWMA)



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Platte Valley Nitrogen and Irrigation Management Demonstration Project

Over the life of the project, average values:

Expected corn yield	11.0 Mg/ha
Actual corn yield	10.7 Mg/ha
Recommended N rate	145 kg/ha
Soil N credit	75 kg/ha
Irrigation water N credit	31 kg/ha

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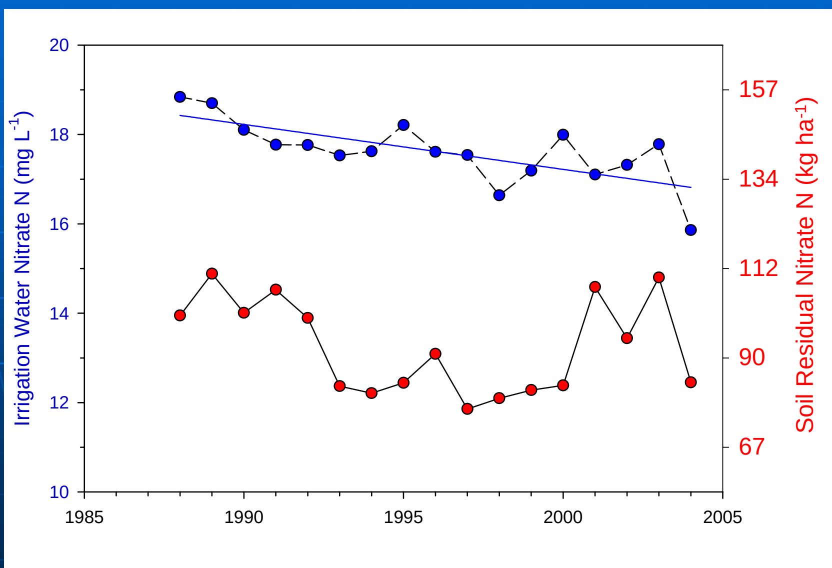
Trends in the Central Platte Valley



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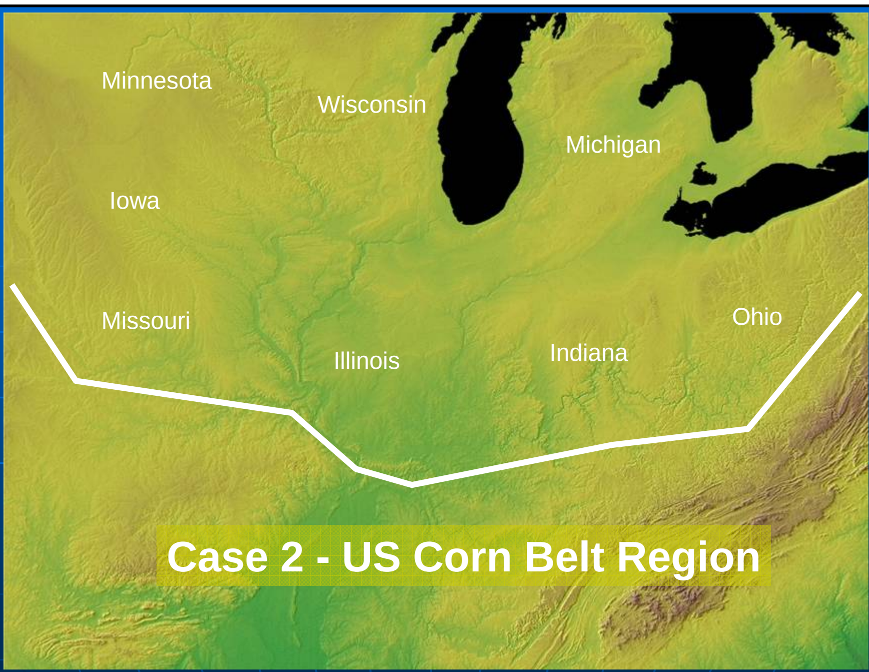


Case 2 - US Corn Belt Region

Figure 1. Mississippi River drainage basin, major tributaries, and areal extent of 1999 midsummer hypoxic zone.

Fertilizer N, kg km^{-2} year^{-1}

N loss, kg km^{-2} year^{-1}

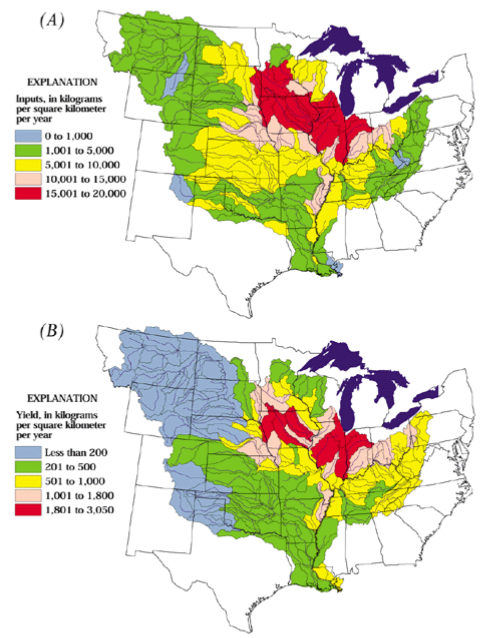


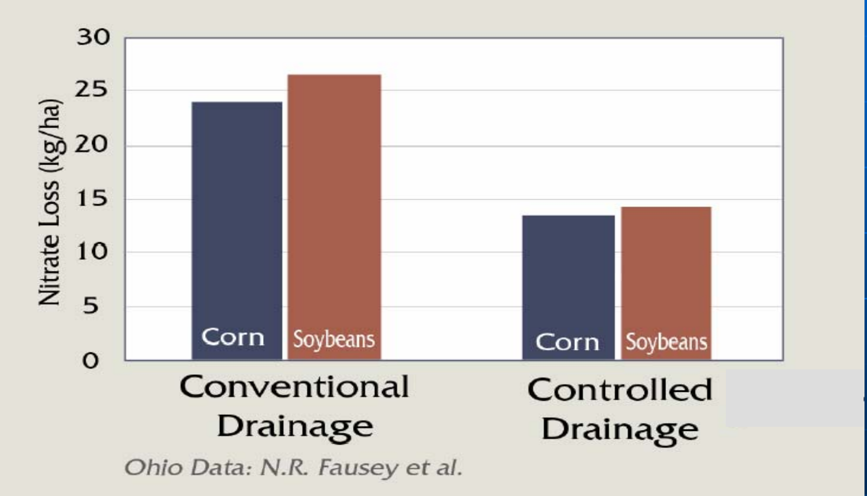
Figure 6. *(A)* Nitrogen inputs during 1992 and *(B)* average annual nitrogen yields of streams for 1980–96 (modified from Goolsby and others, 1999).

US Corn Belt Tile-Drained Lands

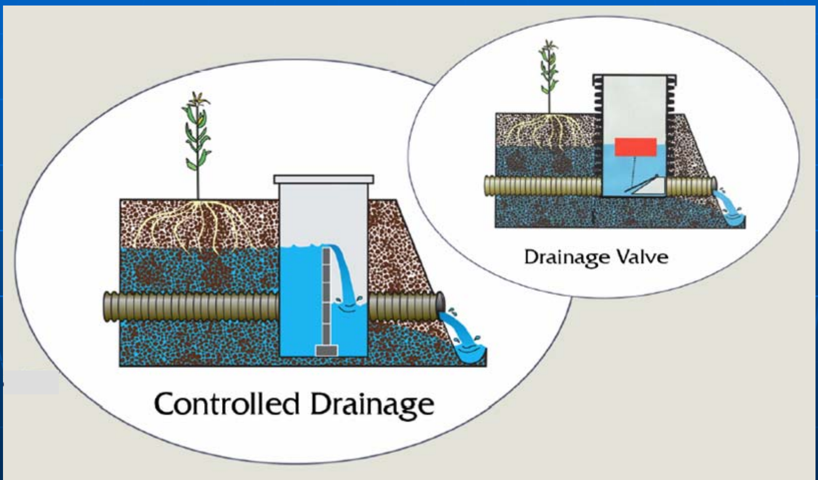
- >200,000 km^2 in US Midwest
- Subsurface and surface drainage
- Documented loss of nitrate to streams
- Contributes to Gulf of Mexico hypoxia
- Potential to reduce nitrate loss by 30-50%

The Problem Nitrate loss from uncontrolled surface and subsurface drain outlets in the midwest.

Effect of Controlled Drainage on Nitrate Loss



Methods to Control Drainage



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Case study 3 - Lower Mississippi River Valley (LMRV) Delta

- All was cypress swamps, cut for timber in late 1800's.
- Surface drainage was done in early 1900's.
- It has ~70,000 km^2 of cropland, with very little other industry.
- Approximately half is irrigated.
- The LMRV is where new irrigation is being added in the USA.
- Alluvial Aquifer is a good irrigation water supply.
- Despite that, some areas now have water shortages.

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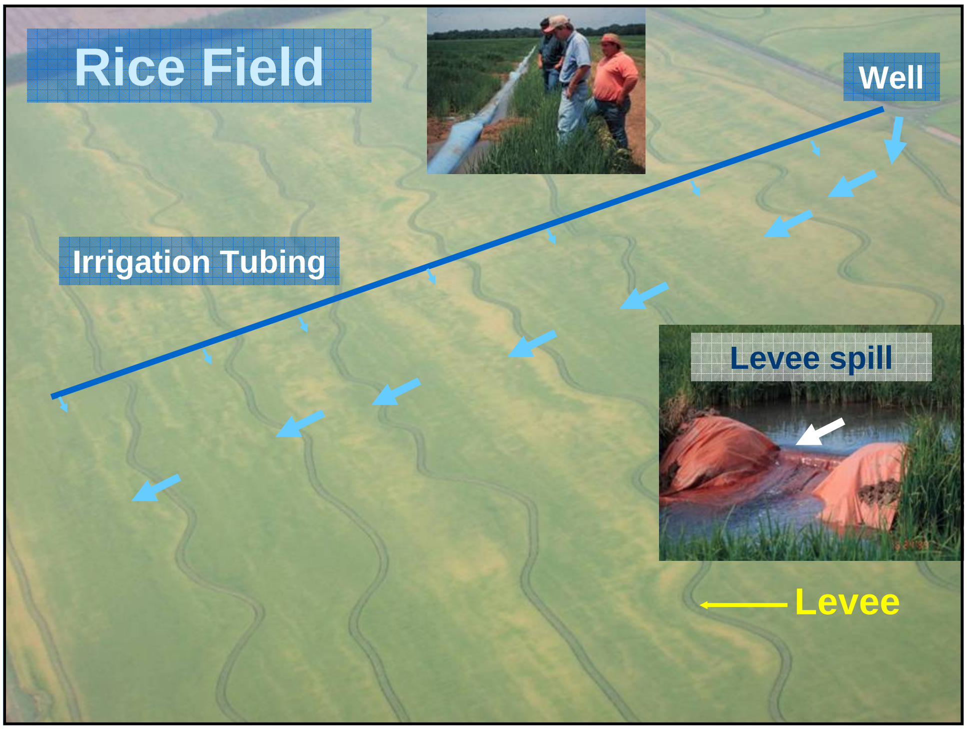

Case 4 - Precision Irrigation Florence SC

- Modified commercial center pivot
- Control 9-m sections independently
- Used it to find production functions for water and N for corn

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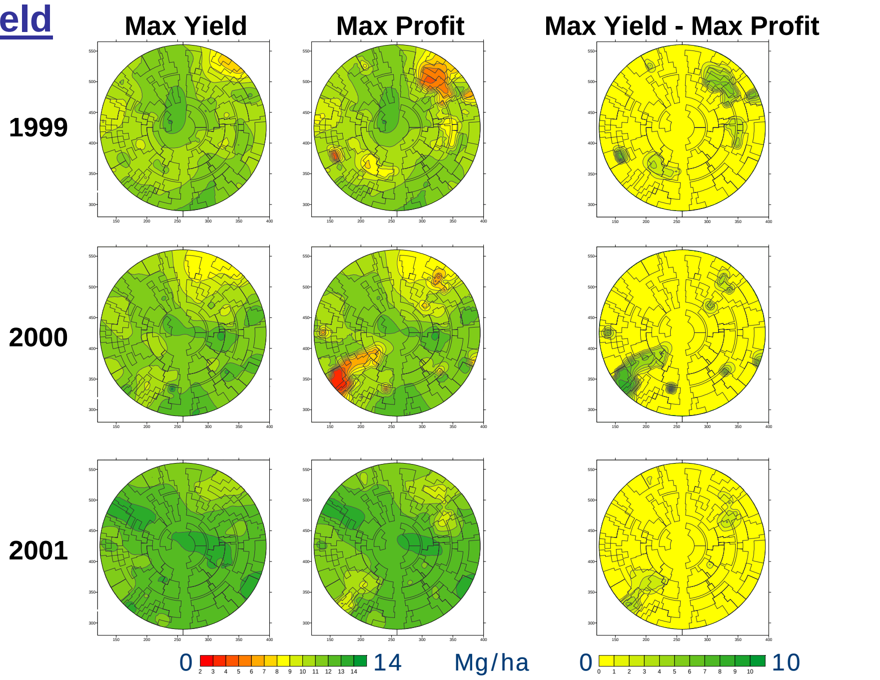
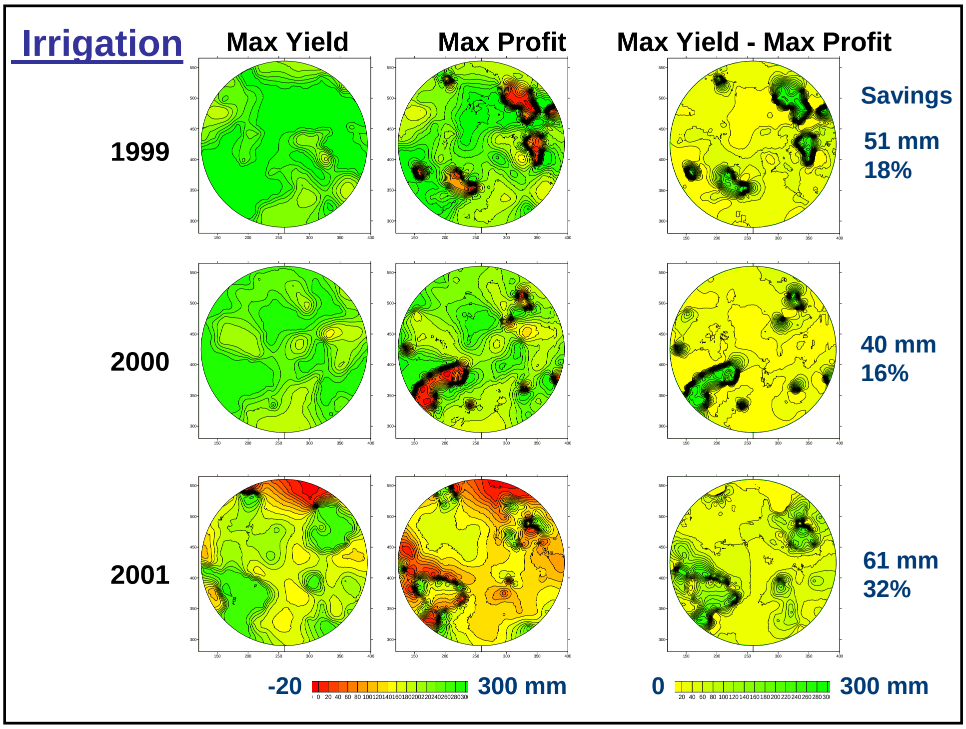
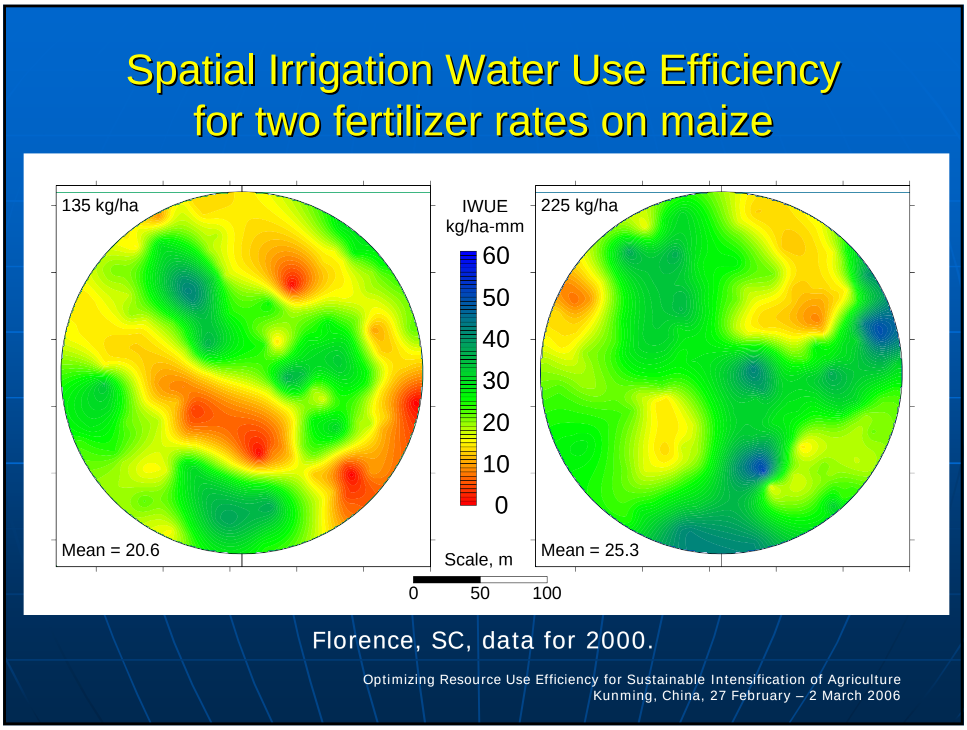
Yield




Irrigation
Max Yield
Max Profit
Max Yield - Max Profit
Savings
1999
51 mm
18%
2000
40 mm
16%
2001
61 mm
32%
-20
300 mm
0
300 mm


Spatial Irrigation Water Use Efficiency
for two fertilizer rates on maize
135 kg/ha
Mean = 20.6
IWUE
kg/ha-mm
60
50
40
30
20
10
0
Scale, m
0
50
100
225 kg/ha
Mean = 25.3
Florence, SC, data for 2000.
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Calculated N Use Efficiency (marginal response to N)

$$NUE = \frac{Y_H - Y_L}{N_H - N_L}$$

Where

Y	=	yield, kg/ha
N_H	=	225 kg/ha
N_L	=	135 kg/ha

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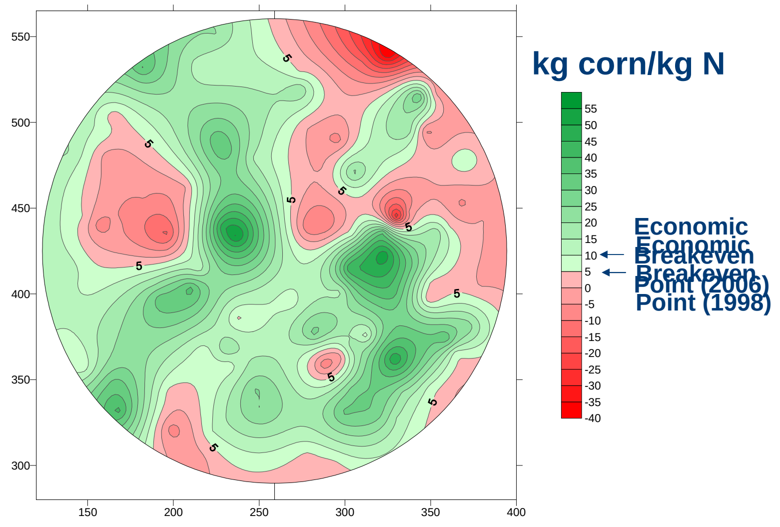
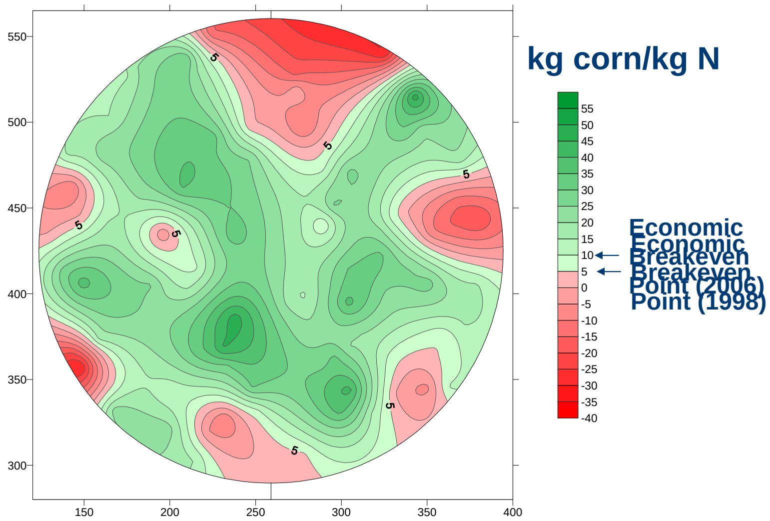
Marginal corn yield benefit from N fertilizer
150% irrigation, 2000



Marginal corn yield benefit from N fertilizer 150% irrigation, 2001



Conclusions

- WUE can be improved
  - Identify and reduce losses of water
  - Increase yield
- Must address both WUE and fertilizer use efficiency, particularly N
  - Identify and reduce losses of N (P, K…)
  - Optimize irrigation with N (P, K…)