The Feasibility of Improving Water Quality in the Cheney Lake Watershed

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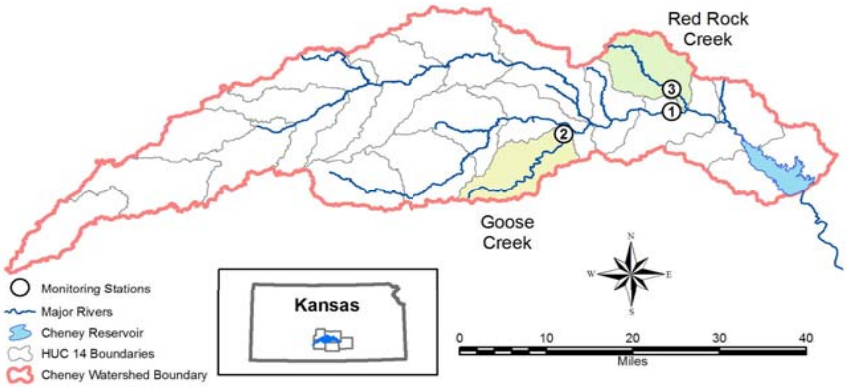
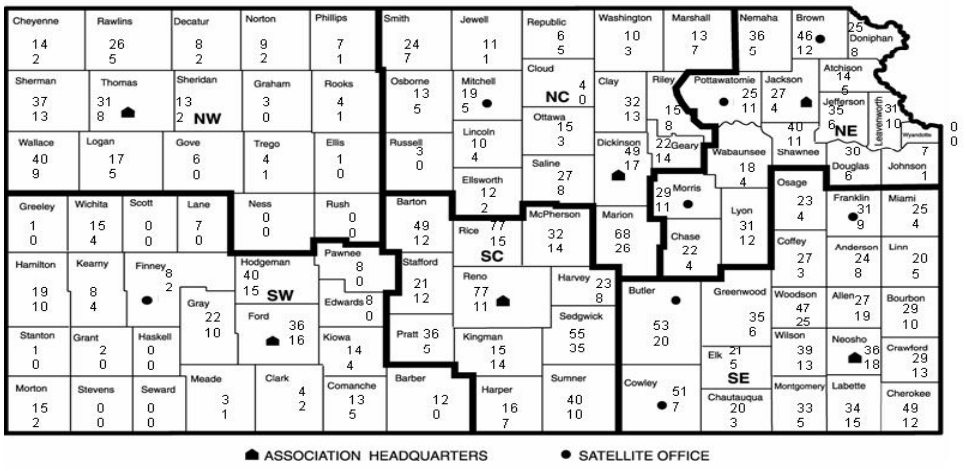
Introduction

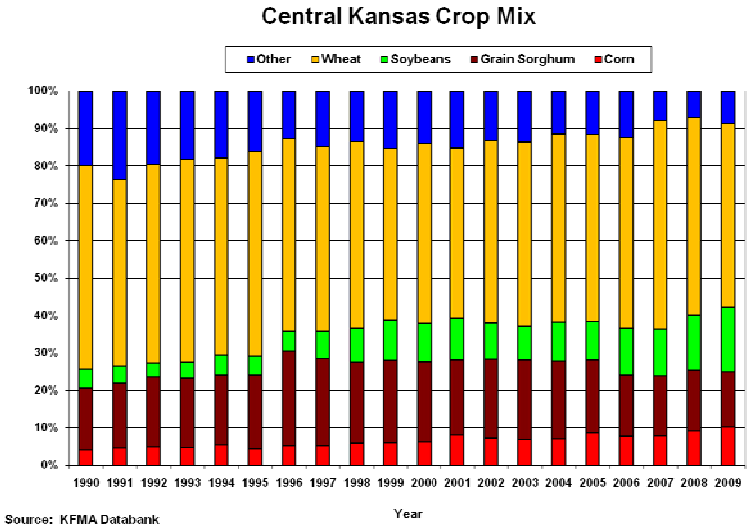
- Controlling water quality typically involves switching to rotations that either have a lower net return, higher risk, or both.
- Because of the potential changes in net return and risk resulting from attempts to improve water quality, it is important to examine the tradeoffs between net return, risk, and water quality.
- This study examined crop rotations in South Central Kansas.

Cheney Lake Watershed

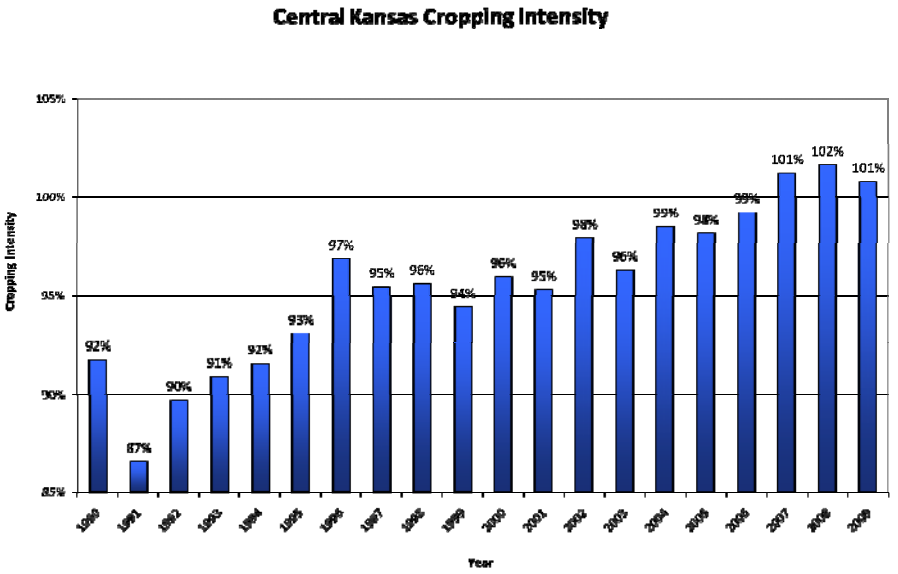


Kansas Farm Management Association





Source: KFMA Databank



Source: KFMA Databank

Data and Methods

- Kansas Farm Management Association (KFMA) Data
  - Central KFMA farms with continuous data from 2005 to 2009
  - Attempt to quantify cropping practices, efficiency, and financial performance gains for no-till production systems
  - Farms were designated as no-till or mixed tillage
    - 280 mixed tillage farms
    - 85 no-till farms

Data and Methods

- Simulation Model: Crop Rotations
  - Continuous Wheat
    - Conventional till
    - Reduced till
  - Wheat/Grain Sorghum/Soybean
    - Conventional till
    - Reduced till
    - No-till
  - Alfalfa/Wheat

Data and Methods

- Data for Budgets and Simulation Model
  - Soil Type: Nalim Loam, 0 to 1% slopes
  - Water Quality: SWAT
  - Crop Yields: SWAT
  - Cost and Price Estimates:
    - Farm management guides
    - Agronomic publications
    - Kansas Agricultural Statistics
    - FAPRI – University of Missouri

Data and Methods

- Water Quality Variables
  - Runoff
    - Water yield
    - Sediment yield
  - Total Phosphorus
    - Organic
    - Mineral
    - Soluble

Data and Methods

- Water Quality Indices
  - To facilitate comparisons among crop rotations, the values of the three water quality variables were assigned a value of 1.0 for the base rotation, continuous wheat under a conventional tillage production system.

Data and Methods

- Target MOTAD Model
  - Objective Function
    - Maximize net return to land and management per acre
  - Constraints
    - Downside risk
      - Average annual deviations below target income of $45 per acre
    - Water quality
  - Trace out risk/return frontier by changing level of allowable deviations below target income

KFMA Analysis

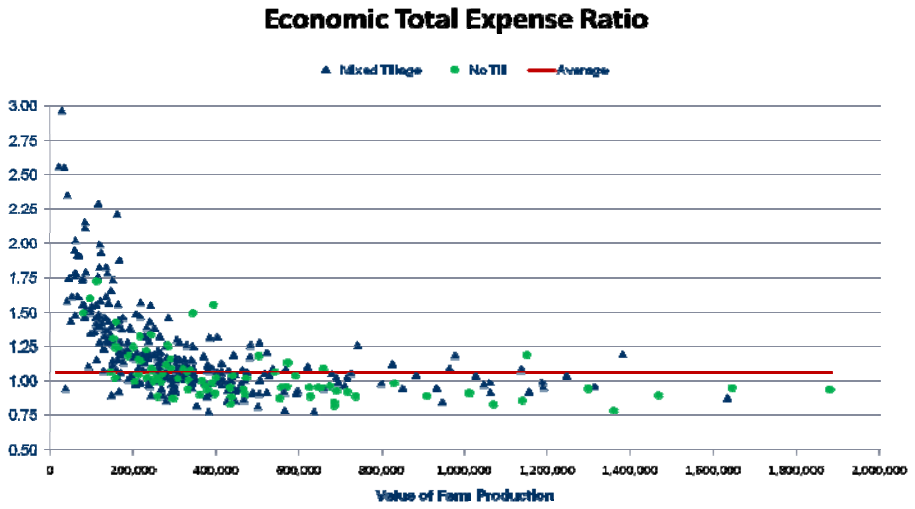
Item	No-Till	Mixed Till	Significantly Different
Crop Acres	1,724	1,303	yes
Harvested Acres	1,840	1,304	yes
Value of Farm Production (VFP)	$485,682	$328,414	yes
Net Farm Income (NFI)	$121,743	$69,244	yes
Gross Crop Value per Acre	$303.87	$271.18	yes

KFMA Analysis

Item	No-Till	Mixed Till	Significantly Different
Crop Intensity Index	1.067	1.001	yes
% Crop Acres Planted to Wheat	41.94%	52.65%	yes
% Crop Acres Planted to Feed Grains	30.63%	23.25%	yes
% Crop Acres Planted to Oilseeds	23.84%	13.20%	yes

KFMA Analysis

Item	No-Till	Mixed Till	Significantly Different
Economic Total Expense Ratio (ETER)	0.987	1.098	yes
Operating Profit Margin Ratio	0.1861	0.1232	yes
Asset Turnover Ratio	0.4284	0.3365	no
Machinery Investment per Crop Acre	$150.06	$151.47	no
Machinery Cost per Crop Acre	$57.25	$66.98	yes
Labor Cost as a Percent of VFP	13.80%	17.07%	yes



Simulation Results

- Risk and Return for each Crop Rotation
- Target MOTAD Frontiers
  - Profit Maximum
  - Low Risk
- **Note:**
  - **Results are preliminary.**
  - **Further results will be posted to Ag Manager web site: www.agmanager.info**

Continuous Wheat

	W-CT	W-RT
Net Return	$20.60	$51.86
Risk	29.16	10.83
Water Yield	1.000	0.917
Sediment Yield	1.000	0.403
Total Phosphorus	1.000	0.433

Wheat/Grain Sorghum/Soybean

	WGS-CT	WGS-RT	WGS-NT
Net Return	$28.22	$47.01	$48.67
Risk	29.84	19.52	18.69
Water Yield	1.578	1.309	1.083
Sediment Yield	2.273	1.167	0.522
Total Phosphorus	2.085	1.150	0.655

Target MOTAD Solutions

	Profit Maximum	Low Risk
Net Return	$61.38	$60.24
Risk	6.79	2.77
Water Yield	0.861	0.920
Sediment Yield	0.379	0.422
Total Phosphorus	0.408	0.487
W-RT	0.920	0.564
WGS-NT	0.000	0.356
AW	0.080	0.080

Summary

- This study examined crop rotations in South Central Kansas.
- Adding an alfalfa rotation to the crop rotation mix improved net return, lowered risk, and improved water quality.
- In addition to alfalfa, the optimal crop rotation mixes included continuous wheat under a reduced tillage production system and wheat/grain sorghum/soybean rotation under a no-till production system.

Future Work

- Results will also be generated for additional soil types including Farnum and Funmar loams, 0 to 1% slopes; and Saltcreek and Naron fine sandy loams, 1 to 3% slopes.
- In addition to continuous wheat, wheat/grain sorghum/soybeans, and alfalfa/wheat the following crop rotations will be examined:
  - Wheat/Wheat/Grain Sorghum/Grain Sorghum
  - Corn/Soybean
  - CRP
  - Switchgrass

Contact Information

- Michael Langemeier
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  - Ag Manager Contributor Site (www.agmanager.info)
    - KFMA Newsletter
    - Recommendations for Further Reading