Ethanol and the Mid-Atlantic: Unintended Consequences and Opportunities for Water Quality

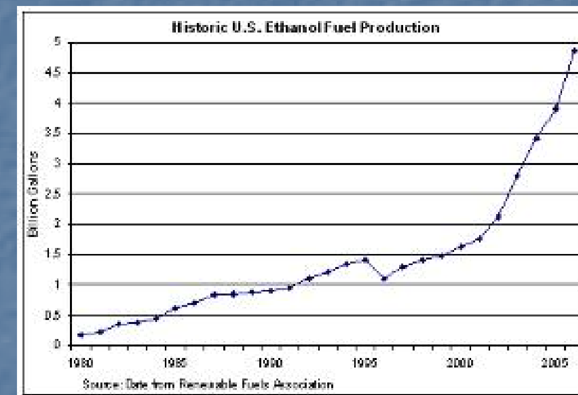
Jake Vandevort
Mid-Atlantic Water Program
February 6, 2008

Applying knowledge to improve water quality
Mid-Atlantic Regional Water Program
A Partnership of USDA CSREES & Land Grant Colleges and Universities

CSREES USDA EDUCATION RESEARCH EXTENSION

Ethanol – A National Effort

- 2007 State of the Union - National goal of reducing gasoline usage by 20% by 2017
- Renewable Fuels Association is promoting the 25x25 initiative
- 2007 Energy Independence and Security Act raised renewable fuels standard to 36 billion gallons by 2022
- Corn currently >90% of the feedstock for ethanol production
- Status of Ethanol Plants as of 1/24/2008
  - 163 biorefineries operational
  - 329 biorefineries planned
  - 75 biorefineries under construction



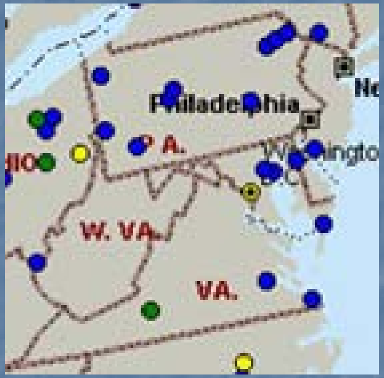
Source: DTN Ethanol Center

Biofuels & Water Quality Conference

- Ethanol gaining attention, but little discussion of its long-term sustainability of effects on water
- Conference convened on April 4-5, 2007 in Beltsville, MD
- Convened to identify and discuss the impacts from growing and using agricultural-based feedstocks for biofuels production
- Attracted 150 people from throughout the region and country
- Speakers authored a summary document entitled “Biofuels and Water Quality – Meeting the Challenge and Protecting the Environment”
- Generated national interest and multiple newspaper articles

Ethanol in the Mid-Atlantic

- ~15 ethanol facilities under construction or planned for the region
  - Maryland – 3
  - Pennsylvania – 9
  - Virginia – 4
- If built – One billion gpy capacity using corn grain as primary feedstock
- Would require 370 million bushels of corn per year – 1.5 times current regional production of corn
- 300,000 additional acres of corn were planted in the region during 2007



Source: DTN Ethanol Center

Photo by Bob Nichols, USDA-ARS

Unintended Consequences

- Environmental Impacts
  - Nutrient Loss
  - Soil Erosion and Degradation

- Feed Management & Animal Agriculture Impacts

- Economic Impacts

Environmental Impacts

- Ethanol production in the region will impact the environment
- Estimate that between 500,000 and 1 million new corn acres will be planted in the Chesapeake Bay watershed over the next several years
- Farmers planted an additional 300,000 acres in 2007
- Increased nitrogen fertilizer use
- Continuous corn will replace corn-soybean rotations
- Conversion of land to corn production will make it difficult not to increase nutrient losses

Nutrient Losses - Nitrogen

- Nitrogen loads from corn dominated landscapes are typically 20 to 40 lbs/acre
- N loss in soybeans is somewhat less (15 to 30 lbs/acre)
- Estimate 30% of cotton, 15% of dry hay and 10% of CRP acres in corn production counties will be converted to corn
- Potential net N losses on converted land estimated to be between 8.0 and 16.0 million pounds for the Bay region
- Bay states already agreed to 110 million pound reduction in annual loads of nitrogen

Cropping Changes	Expected N Loss (lbs/ac)	500,000 Acres		1 Million Acres	
		Acreage ('000)	Increased N Loss (m. lbs)	Acreage ('000)	Increased N Loss (m. lbs)
New Corn Acres	30	500	+ 15.0	1,000	+ 30.0
Soybeans	22.5	236	- 5.3	472	- 10.6
Cotton	14.25	11	- 0.15	22	- 0.3
CRP	3	16	- 0.05	32	- 0.1
Hay	6	250	- 1.5	500	- 3.0
Potential N Loss Increase (m. lbs)			+ 8.0		+ 16.0

Potential Nitrogen Losses from New Corn Acres in DE, MD, NY, PA and VA

Nutrient Losses - Phosphorus

- Same land conversion assumptions as N estimates
- P losses similar between corn and soybeans
- Half of converted land assumed to have no change in P loss
- Conversion of CRP, idle land, pasture or hay will result in major increases in losses
- Estimates of 3 to 5 lbs/acre typical for corn or soybeans.
- Losses from CRP, idle land, pasture or hay typically < 1 lb/acre
- Estimated increase in P losses of 0.8 to 1.6 million pounds per year

Cropping Changes	Expected P Loss (lbs/ac)	500,000 Acres		1 Million Acres	
		Acreage ('000)	Increased P Loss (m. lbs)	Acreage ('000)	Increased P Loss (m. lbs)
New Corn Acres	4	500	+ 2.0	1,000	+ 4.0
Soybeans	4	236	- 0.944	472	- 1.888
Cotton	4	11	- 0.044	22	- 0.088
CRP	0.75	16	- 0.012	32	- 0.024
Hay	0.75	250	- 0.188	500	- 0.375
Potential P Loss Increase (m. lbs			+ 0.812		+ 1.625)

Potential Phosphorus Losses from New Corn Acres in DE, MD, NY, PA and VA

Erosion & Soil Degradation

- Increased pressure to bring hay, pasture and marginal lands into corn production
- Increased soil loss and erosion
- Reduced soil organic matter and soil quality from widespread harvest of corn grain-stover for cellulosic ethanol production
- Increased soil carbon release as opposed to carbon sequestration if corn stover is harvested for cellulosic uses.
- Conversion of corn-soybean rotations to continuous corn will likely necessitate increased tillage.
- Potential long-term yield impacts.

Economic Impacts

- For the last several decades corn has been in the $2.00 - $2.50/bushel range
- Current corn futures prices are ~$ 5.00/bushel
- Farmers are getting a good price, but animal feed prices have increased
- Will increase the cost of incentive and conservation programs

Feed Management & Animal Ag

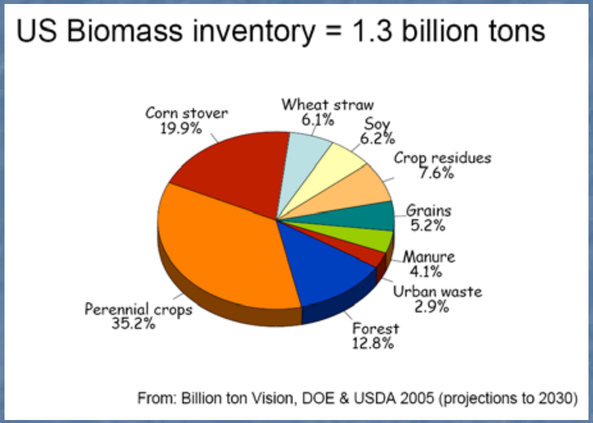
- High corn prices mean higher profits for corn producers, but will increase grain costs for feed
- Co-locating animal agriculture operations near ethanol plants will contribute to nutrient imbalances
- Use of Dried Distiller's Grains (DDGs) in feed will mean more soluble P in feeding rations
- Due to use of DDGs, manure generated around facilities will be higher in N & P concentration
- May reverse much of the progress feed management programs have achieved in reducing N & P in animal wastes

Opportunities for Water Quality

- Cellulosic Feedstocks
- Environmental Benefits & Opportunities
- Economic Benefits of Using Cellulosics

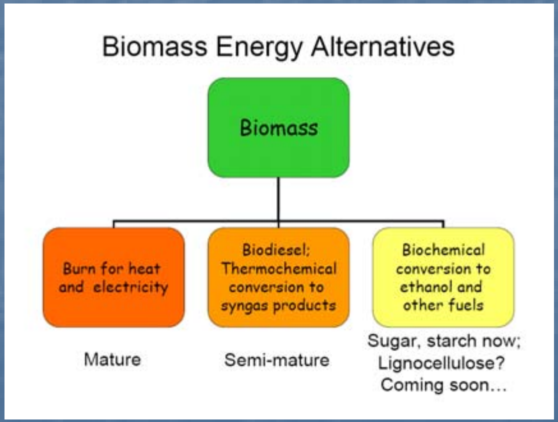
Cellulosic Feedstocks

- Perennial grasses are currently considered the most promising sustainable cellulosic feedstock
- The necessary technology and infrastructure for cellulosics is likely still a decade away
- Considerable interest in switchgrass, which offers clear environmental benefits over a corn grain-stover energy strategy



Environmental Benefits & Opportunities

- Develop a "Biomass Reserve Program" comparable to the Conservation Reserve Program
- Develop a "Biomass Innovation Grant" program comparable to the Conservation Innovation Grants
- Switchgrass can be grown on marginal lands, or as a buffer
- If switchgrass is used instead of corn, N & P losses can be reduced by more than 75%
- Switchgrass will sequester carbon, increase soil organic matter and improve soil quality though an extensive, deep root system



Economic Benefits of Using Cellulosics

- Lower cost to produce over time since switchgrass is a 20+ year perennial
- Greater net energy production than corn. The ligno-cellulosic co-product can be burned and used to provide energy for the ethanol facility
- Does not directly compete with feed
- Serves as topgrowth for biofuels
- Creates opportunities for soil quality credits (CSP) and tradable carbon and nutrient credits

Conclusions

- The corn ethanol industry is rapidly creating unintended consequences for feed, fuel and water
- Minimizing environmental impacts from expanded corn grain ethanol production will be difficult
- There are technology and infrastructure constraints for cellulosic-based ethanol production
- Perennial grass-based ethanol production provides multiple economic and environmental benefits

Conclusions

- Need to look at opportunities to minimize impacts
- Use intensive conservation practices to offset the increase in nitrogen losses from additional corn acreage
- Stringent nutrient management plans that are fully implemented
- Increased use of appropriate cover crops
- Continue to explore cellulosic-based opportunities for ethanol. Develop the infrastructure necessary to make cellulosic ethanol a viable alternative

Questions?

Thank You

www.mawaterquality.org/biofuels

Jake Vandevort
University of Maryland
jvandevo@umd.edu