Impacts of Increased Bio-Fuel Production on the Midwest Landscape

Presented by the Soil and Water Conservation Society:
West North Central Region
Dubuque, Iowa • October 16-17, 2007

Concurrent Presentation Schedule

Modeling: Papers that discuss how bio-fuel production may affect water quality. Results are obtained from the use of simulation models. *These abstracts are printed in the order of presentation, beginning on page 2.*

3:00 p.m. **Erosion, Nutrient Loss, and Carbon Sequestration Estimates for Alternative Bio-Fuel Products in Missouri.** Verel W. Benson, Food and Agricultural Policy Research Institute (FAPRI)

3:30 p.m. **Environmental Implications of Bio-fuel Production on a Central Iowa Watershed.** Brian Gelder, Iowa State University

4:00 p.m. **Converting CRP Land to Corn: Impacts and Mitigation.** John Panuska, University of Wisconsin

4:30 p.m. **Environmental Consequences of Increased Bio-fuel Production in U.S. Midwest.** Katsuya Tanaka, Hiroshima University

Alternative Bio-fuels: Papers that discuss the use of alternative bio-fuels (other that corn) and their environmental impacts. *These abstracts are printed in the order of presentation, beginning on page 4.*

3:00 p.m. **Combining Forest Management (Thinning) and Bio-energy Production in Missouri.** Hank Stetzler, University of Missouri

3:30 p.m. **Cellulose Prairie: Biomass Fuel Potential in Wisconsin and the Midwest.** Brett Hulsey, Better Environmental Solutions **(NEW)**

4:00 p.m. **The Chariton Valley Biomass Project in Iowa Switch-grass to Electric Energy.** Dora Guffey, Chariton Valley RC&D.

4:30 p.m. **Minimal Surface Impact Bio-fuels underground algae farming.** David A. Summers, University of Missouri-Rolla

Wildlife: Papers that discuss how bio-fuel production may affect wildlife diversity and habitat. *These abstracts are printed in the order of presentation, beginning on page 6.*

1:00 p.m. **Positive Effects of Agricultural Land Use Changes through the Conservation Reserve Program and Other Programs on Cold Water Fish Communities in Southwest Wisconsin Streams.** Jim Bauman, Wisconsin Department of Natural Resources

1:30 p.m. **Challenges and opportunities for wildlife from bio-fuels.** Tim McCoy, Nebraska Game and Parks Commission

2:00 p.m. **Adding biofuels to the invasive species fire?.** Adam Davis, USDA-ARS, Invasive Weed Management Unit

Policy: Papers that discuss policy or the need for policy. *These abstracts are printed in the order of presentation, beginning on page 7.*

1:00 p.m. **The Impact of Bio-fuel Production on Biodiversity: A National and World Perspective.** Dennis R. Keeney, Institute for Agriculture and Trade Policy

1:30 p.m. **Energy security? The framing of bio-fuels in the 2007 Farm Bill debates.** Nadine Lehrer, University of Minnesota

2:00 p.m. **What is The Value of My Crop Residue?.** Doug Karlen USDA ARS National Soil Tilth Lab

Impacts of Increased Bio-Fuel Production on the Midwest Landscape
Presented by the Soil and Water Conservation Society:
West North Central Region
Dubuque, Iowa • October 16-17, 2007

Abstracts

Modeling – Tuesday, October 16 - 3:00 p.m. to 5:00 p.m.

Erosion, Nutrient Loss, and Carbon Sequestration Estimates for Alternative Bio-Fuel Products in Missouri.

Verel W. Benson, Food and Agricultural Policy Research Institute (FAPRI), BensonV@missouri.edu

The energy-from-wood industry has been deterred by the high cost of harvesting and collecting the biomass; lack of infrastructure for marketing woody biomass fuel products; obsolete conversion technologies; disproportionate emphasis on competing fuels; and failure to give appropriate consideration to the environmental, national security, and economic benefits of using wood for energy (Zerbe, 1988). Even though the technology for converting wood to energy has advanced over the past decade and a half, many of these deterrents still exist.

The environmental and regional economic benefits from the combination of renewable energy production and forest enhancement need to be quantified to show the value of public and private investment in improved forest management. This paper presents the results of an integrated effort by foresters, economists, and environmental modelers. It quantifies the availability of forest biomass by 300 meter grid for southeast Missouri, the regional economic value, and the types of biomass systems which may be economically viable. Four bio-energy options are considered:

1) burn wood chips to provide heating/cooling schools, hospitals and other public buildings,
2) burn wood chips and other fuel to heat/cool large multi-building facilities such as universities,
3) burn wood chips and other bio-fuels to generate electricity, and
4) produce ethanol.

Some of these systems would be considered risky investments if only private costs and returns are considered. However, considerable public benefits in terms of regional economic growth and environmental enhancement could be used to stimulate public investment in the form of grants, guaranteed loans, and low interest loans.

Environmental Implications of Biofuel Production on a Central Iowa Watershed.

Brian Gelder, Iowa State University, bkgelder@iastate.edu

Biofuels production will have numerous environmental consequences of importance for soils, with impacts on soil carbon, fertility, erosion, and soil moisture, with the greatest concerns predicted to be in the area of erosion and hydrology. Previous studies, such as the DOE Billion Ton Study, have used assumptions to generate a nationwide approximation of the acceptable amount of residue that can be harvested for biofuel production. However, the factors influencing erosion and hydrology are local in nature requiring the use of more advanced models to evaluate the impacts of biofuel production on a local scale. To better clarify the consequences of biofuels production, the Iowa Daily Erosion Project, a

hydrologic model capable of utilizing real-time rainfall and climatology in conjunction with the WEPP erosion model, was updated and modified to reflect current and possible management scenarios for a central Iowa watershed. Erosion, runoff, and soil moisture will be modeled at the field level for the period from 2003 to 2006 using observed management conditions and three different biofuel harvest scenarios, a variable harvest scenario based on field conditions and two different straight percentage harvest scenarios. Model results will be compared between the expected increase in erosion with biomass harvesting and recommendations for sustainable biofuel production will be evaluated.

Converting CRP Land to Corn: Impacts and Mitigation.

John Panuska, University of Wisconsin – Madison, jcpanuska@wisc.edu

Currently there are more than 600,000 Wisconsin acres enrolled in the USDA's Conservation Reserve Program (CRP). The contracts for approximately 45 percent of these acres may expire between 2007 and 2009. Because of their vulnerability to erosion, CRP lands were removed from production and placed in perennial cover where soil and nutrient losses are minimal. Interest in ethanol production has created increased demand for corn that could result in CRP acres going back into corn production, potentially increasing sediment and nutrient export from these lands and resulting in adverse environmental impacts.

The Snap-Plus nutrient management planning software was used to evaluate the sediment and phosphorus (P) loss for different corn rotations and tillage methods on highly erodible fields (http://www.snapplus.net). Snap-Plus includes RUSLE2 to estimate soil loss and the Wisconsin P Index calculator to estimate P loss. Representative highly erodible field sites were selected using eleven soil mapping units with steep (map units C and D) slopes from WI counties with significant CRP acreages. Snap-Plus was run for each field under grass hay (similar to CRP) and 10 corn-based rotation tillage combinations. Soil and P losses increased when these lands were converted to corn-grain, but the impact can be minimized with no-till or strip-till systems. For most of these fields, removal of the entire corn plant causes soil loss exceeding tolerable limits (T). This application demonstrates how modeling accounts for site specific conditions for evaluating management options and the degree to which site specific conditions impact system responses.

Environmental Consequences of Increased Biofuel Production in U.S. Midwest.

Katsuya Tanaka, Hiroshima University, katsuyat@hiroshima-u.ac.jp
(Authors: Katsuya Tanaka, JunJie Wu, Jerome G. Neppel)

This paper investigates environmental consequences of biofuel crop production, primarily focusing on corn, in the Upper Mississippi River Basin (UMRB). This objective is achieved by applying an integrated modeling system to nitrate-N (NO_3-N) runoff from the UMRB. An integrated modeling system developed in this study consists of an economic model and physically-based hydrologic balance simulation model. The economic model predicts corn acreage at different output price levels in 353 counties in the UMRB. This model is estimated using a series of agricultural and economic data and spatially-explicit locally-weighted regression model (geographically weighted regression; GWR). Using this approach, the model can be fitted at each county, allowing corn acreage response to vary spatially among counties in the UMRB. Based on predicted corn acreage from the economic model, the Soil and Water Assessment Tool (SWAT) is then used to simulate the level of NO_3-N runoff from the UMRB. As a result, our integrated modeling system provides basin-scale simulation of pollutant runoff, while incorporating county-specific corn acreage response to corn price increase.

Our results show that higher corn price resulting from enhanced biofuel production increases considerably NO_3-N runoff from the UMRB. For example, 25 percent increase in corn price will increase the level of NO_3-N runoff by nearly 10 percent due to corn acreage expansion. Because corn price is forecasted to continue to trend upward, policymakers need to consider relevant actions to meet or maintain water quality goals and sustainable agriculture in the region.

Alternative Bio-fuels – Tuesday, October 16 - 3:00 p.m. to 5:00 p.m.

Combining Forest Management (Thinning) and Bioenergy Production in Missouri.
H.E. "Hank" Stetzler, University of Missouri, StelzerH@missouri.edu

A recent spatial analysis of woody biomass that is potentially available from forest thinning operations has identified several regions in the Missouri Ozarks where a wood-to-energy facility would be feasible. Whether the facility would convert wood to electricity, heat and/or cool buildings, or produce ethanol, the primary source of this biomass would be from family forestland owners.

Having a market for wood that has previously had no value would be a great opportunity for family forestland owners to weed their woodland gardens. By doing so, the site's growth potential would be redirected to higher-value trees and improve the overall health of the forest.

However, the increased demand for this wood coupled with the difficulty of removing low-quality trees while protecting the higher-value trees could lead to high-grading the forest stand or wholesale clearcutting.

Key stakeholders need to be educated with respect to the potential and pitfalls of wood-to-energy operations. A comprehensive spatial analysis can greatly assist this effort. By integrating (1) the results from our spatial analysis, (2) information from the National Agricultural Imagery Program showing recent harvesting operations, (3) data layers from the U.S. Forest Service's Spatial Analysis Project showing priority areas in the state and the location of land parcels practicing good forest management, and (4) data from the Missouri Department of Natural Resources showing the location of distressed watersheds, stakeholders will be able to make informed decisions that can lead to better stewardship of the state's natural resources.

(NEW) Cellulose Prairie: Biomass Fuel Potential in Wisconsin and the Midwest.
Brett Hulsey, Better Environmental Solutions Brett@BetterEnvironmentalSolutions.Com

It's well established that cellulosic biomass, including switchgrass, wood and crop residues, as well as manure, are great potential biofuels and biopower sources.

More surprising is that 12 Midwestern states — the Cellulose Prairie — already generate up to 231 million tons of potential excess biomass each year. If converted to ethanol, this could yield 13.9 billion gallons of fuel, more than doubling current ethanol production … or enough energy to replace 154 million tons of coal, equivalent to one-third (37%) of the coal burned in the 12 states each year.

In fact, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin are home to half of the nation's 466 million tons of excess biomass and three-quarters of the nation's switchgrass and crop residue reserves, making the Midwest the potential "Biofuel Saudi Arabia of America."

Wisconsin alone has almost 15 million tons of potential excess biomass, which could produce 1.3 billion gallons of ethanol per year and displace half of the 2.6 billion gallons of gasoline Wisconsin consumed

last year. This is in addition to Wisconsin's 252 million gallons of current corn ethanol production. This excess biomass could be burned to replace 15 million tons of coal, equivalent to 56% of Wisconsin's total coal use. Notably, these biomass materials are excess or surplus and can be harvested sustainably to maintain forest and soil health.

The Chariton Valley Biomass Project in Iowa: Switchgrass to Electric Energy.

Dora Guffey, Chariton Valley RC&D, dora.guffey@ia.usda.gov

The Chariton Valley Biomass Project began ten years ago as an idea to help protect a watershed that was not only home to a flood control lake that provided recreation benefits to a southern Iowa area, but was also a water source for a rural water system in southern Iowa and northern Missouri. The idea was to take this area that had very highly erodible land, not well suited to traditional row cropping, and provide an alternative crop for the local landowners while at the same time protecting the environment. The planting of switchgrass, a warm season native perennial grass, was then set in place through the Chariton Valley Biomass Project. Through this research and development project conducted with the Department of Energy, Chariton Valley RC&D, Alliant Energy, and numerous other partners, the grass was harvested and converted from biomass to energy at a coal fired power plant.

Benefits seen from this project include improving water quality, air quality, soil tilth, wildlife habitat and reducing soil erosion.

The final testing for this research and development project were concluded in the summer of 2006 and the final report is being compiled, to be completed approximately May of 2007.

Moving forward toward commercialization of this project includes raising switchgrass on approximately 150,000 acres within a potential 70 mile radius of the power plant to provide 200,000 tons of switchgrass per year.

Minimal Surface Impact Biofuels - underground algae farming.

David A. Summers, University of Missouri-Rolla, dsummers@umr.edu

Falling production of many of the world's major oilfields stresses the need for alternative fuel. Biodiesel from algae has a high production rate, 50 gm/sq m/day transiently reached in field tests in New Mexico, gives 2,500 gallons/acre/year if sustained. Use of surface vats had three major problems, evaporation, temperature fluctuations and local species invasion. These can be overcome, with additional benefit, if the farms are set in the abandoned space of underground mines.

Underground provides 3-dimensions - expensive on the surface - but already excavated, increasing algae production. Algae can double their volume up to four times a day, and can contain more than 25% lipids. The problem underground is the loss of the sunlight. Yet underground location allows light used to be optimized for the algae, and can be provided both renewably (solar and wind) or from other fuels (such as nuclear and coal) from power stations in off-peak times, at low cost.

The surrounding rock isolates, and insulates, so it is simple, and inexpensive to hold an optimal temperature. With the algae grown in vats, they will be isolated, also limiting invasion risk by local domestic species, and the converse risk of algal escape.

UMR is using its underground mine near campus, for research to optimize algae growth, including studies to optimize light intensity, color and duration, as well as temperature for the algae tested. The most effective ways to feed CO2, the optimal chemical content in water, and the best harvesting methods are being investigated.

Wildlife – Wednesday, October 17 - 1:00 p.m. to 2:30 p.m.

Positive Effects of Agricultural Land Use Changes through the Conservation Reserve Program and Other Programs on Cold Water Fish Communities in Southwest Wisconsin Streams.

Jim Baumann, Wisconsin Department of Natural Resources, James.Baumann@Wisconsin.gov
(Based on a paper prepared by David W. Marshall, Andrew H. Fayram, John C. Panuska, James Baumann and Joseph Hennessy)

With the increased demand for corn for ethanol and the associated increase in cost for a bushel of corn, the enrollment of critical lands in the Conservation Reserve Program (CRP) is highly likely to decrease. CRP enrollment in the Driftless Area of Wisconsin has been high since its inception in 1986. We sought to quantify the effects of the CPR- associated agricultural land use changes on fish communities. We compared fish index of biotic integrity scores (IBI) and species diversity measures in streams sampled during the 1970's with data from the same locations sampled since 2000. In addition, we examined streams in watersheds without intensive CRP participation but with more traditional agricultural production, in order to detect changes in streams that may have been unrelated to land use changes. Prior to implementation of CRP and other conservation programs, fish communities in the 1970's were generally characterized by high diversity of eurythermal species with low coldwater index of biotic integrity scores. We found significant improvement in IBI scores and declines in species richness in streams where land use changes were evident. We found no changes over time in coldwater IBI scores in streams were CRP participation was low. Recent surveys in streams with dramatic changes in agricultural land use demonstrated that fish populations had shifted to stenothermal cool and coldwater species typical of trout streams. We conclude that fish community structure was positively affected by changes in agricultural land use associated with CRP.

Challenges and opportunities for wildlife from bio-fuels.

Tim McCoy, Nebraska Game and Parks Commission, tim.mccoy@ngpc.ne.gov

America's farm and ranchlands, traditionally having been recognized for food and fiber production, are now being looked to as a source for energy in the national quest for energy independence. National focus continues for the use of cleaner, renewable energy fuels in homes, businesses and transportation. Renewable energy sources on America's farm and ranchlands include wind power, solar power, and biomass fuels. Both short and long-term predictions of energy use, as well as national energy security issues, have led to a focus on biofuels produced from agricultural lands. The use of biomass to create energy brings potential opportunities for truly "green" fuels processed from perennial feedstocks that protect soil and water quality, improve wildlife habitat, and sequester carbon. This presentation will focus on the challenges and opportunities for integrating wildlife habitat and wildlife benefits into the production and harvest of biofuel feedstocks. Wildlife benefits from biofuels crops will largely depend on what plant sources are used, where those feedstocks are grown, what is planted, and how the biomass is managed and harvested. The accelerating interest and development in biofuels is creating new resource challenges; those challenges can best be met proactively in developing win-win situations for biomass production and environmental services.

Adding biofuels to the invasive species fire?

Adam Davis, USDA-ARS Invasive Weed Management Unit, adam.davis@ars.usda.gov

Non-native (alien, introduced, non-indigenous) plants have served as valuable crops throughout history. Increasingly, research has been directed towards identifying new biofuel crops, including non-

native species, as sources of energy. Several plant traits deemed characteristics of an ideal biomass crop are also features commonly found among invasive grasses: low energy into maintenance relative to the production of energy-rich biomass; efficient use of light, water and nutrients; C_4 photosynthesis; nutrient translocation to storage organs during the non-growing season; and perennial growth. Some candidate species for biofuels, such as *Miscanthus x. giganteus* and *Arundo donax*, have many of these same traits. Introducing some plants as biofuel sources may be safe, but this assurance will only be evident following explicit agronomic and ecological risk-benefit analyses, which are already mandatory for the introduction of other potentially beneficial species. Such analyses will require agronomists and invasion biologists to collaboratively assess ecological risks *prior* to introducing potentially beneficial crops, or in carefully quarantined field plots, to ensure that we do not inadvertently add biofuels to the already raging invasive species fire.

Policy – Wednesday, October 17 - 1:00 p.m. to 2:30 p.m.

The Impact of Biofuel Production on Biodiversity: A National and World Perspective.

Dennis R. Keeney, Institute for Agriculture and Trade Policy, drkeeney@iastate.edu
(Authors: Dennis R. Keeney, Mark Muller, Claudia Nanninga)

While biofuel production has local, state and regional implications, in reality this is a global issue. Ethanol and biodiesel are on the verge of becoming internationally traded commodities, and many countries are adopting renewable fuel standards. Marketing of ethanol from maize in the U. S. and sugarcane in Brazil promises to put major pressures on land resources and diversity of plant and animal species both in the Corn Belt region of the U. S. and in the Cerrado and Atlantic rain forest of Brazil. In the Midwestern U. S., a significant amount of land currently in permanent grass and in conservation reserve may be converted to maize. Further, the long standing maize-soy-rotation is moving to one with at least two years of maize, perhaps more. Loss of biodiversity is assured. In Europe, biofuels take more the form of biodiesel and considerable emphasis is placed on import of biofuels. While soy is an efficient producer of biodiesel, palm oil has proven to be the highest yielding lowest cost source. Palm oil production centers in Malaysia and Indonesia as well as the Congo. Major impacts on rain forests in these countries are predicted as palm oil production expands. There are other impacts of biofuel production that must be considered. For example, in Brazil, expansion of sugarcane will push soy production into the more fragile Amazon. Now is a critical time for using policy, research, and market forces to shift the biofuel industry towards a more sustainable system that protects and enhances biodiversity.

Energy security? The framing of biofuels in the 2007 Farm Bill debates.

Nadine Lehrer, University of Minnesota, lehr0037@umn.edu

A year ago, agricultural policy commentators were predicting large-scale changes for the 2007 Farm Bill as WTO negotiations pushed Congress to limit traditional commodity subsidies. One year later, however, stalled negotiations, a booming biofuels market, Democratic Congress, and tight budgets have speculators predicting much less change. This difference in outlook from one year to the next is striking. It highlights the shifting backdrop against which interest groups frame and promote their Farm Bill positions for Congress and the public. These groups' framings in turn affect the kinds of policy alternatives that can be considered and the kinds of financial and political support that can be garnered. This research will focus on the influence of language in the Farm Bill debates – on the role of phrases such as "energy independence" and "energy security" in the debates, and on their implications for agricultural policy. It will argue that these patriotic framings of renewable energy serve to build a

broad base of support for biofuels development among unusual allies that include among others commodity groups and environmental groups. Further, these unusual coalitions are able to argue for policies that indirectly serve to maintain current farm policy provisions and the current agricultural system in the name of promoting energy security. Based on interviews, participant observation, and document analysis, this paper provides insight on the role of language and framing of biofuels in the 2007 Farm Bill debates, and will speculate on implications for policy and corresponding patterns of land use.

What Is The Value of My Crop Residue?

Doug Karlen, USDA ARS National Soil Tilth Lab, karlen@nstl.gov
(Authors: Doug Karlen and Stuart Birrell)

Crop residue has been identified as a near-term source of biomass for renewable fuel, heat, and power. To meet this need without damaging soil, water, and air resources, agriculturalists throughout the world must collectively develop sustainable management strategies that go well beyond the perception that crop residues are “trash.” This presentation will outline research activities associated with the USDA-ARS Renewable Energy Assessment Project (REAP) team. Objectives established for this multi-location team include: (1) determining the amount of residue needed to protect the soil resource, maintain soil organic carbon (SOC), and productivity; (2) estimating the trade-off between the short-term economic return to growers who harvest crop residues as a bio-energy feedstock versus the long-term benefits to soil, water, and air resources associated with building SOC and sequestering C; (3) developing robust algorithm(s) to guide the amount of crop residue that can be sustainably harvested as feedstock without degrading the soil resource, environmental quality, or productivity; and (4) developing management strategies supporting sustainable harvest of crop residue. Among the studies associated with the REAP project is one conducted on Des Moines lobe soils where harvesting crop residue one time decreased subsequent soybean yield by 50% compared to where the residues were not removed. For continuous corn, removing residue increased grain yield in the following year, but overall yield for the field decreased an average of 15 bu/acre despite applying twice as much fertilizer N. Many questions regarding the sustainability of crop residue harvest must be addressed to sustainably support this new agricultural demand.