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Impact of Bioenergy Industry on Soil and Water Resources

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Recent reports and publications such as that of Perlack et al, 2005 and Burton et al, 2006 indicating a high capacity of this nation's lands to produce feedstocks for renewable fuels have created large expectations in rural America, in Congress, and on Wall Street. Meeting these expectations while preserving our soil and water resources may be a challenge or an opportunity, depending upon how the bioenergy industry develops. It presents a challenge because the plant residues serving as our most important soil and water conservation tool are also required for fuel production in the cellulosic liquid fuel industry. It may be an opportunity because a more diverse variety of plant species may eventually be produced on the landscape and these plants, or crops, which help conserve the soil and water resource, may have a market. As the biofuel industry develops, producers may be able to plant perennial grasses or woody species that both have a favorable impact on natural resources and provide income as liquid fuel feedstocks.

What is the concern relative to soil and water resources? Soil erosion and water runoff are greatly impacted by surface residue cover. As cover is reduced, both soil erosion and water runoff increase. Plant species that offer little protective cover after removal of above ground biomass, species such as those grown as row crops, will require diligence in limiting residue removal if soil loss and water runoff are to be maintained at acceptable rates. Research indicates that maintaining soil organic matter contents will require even more conservative residue removal rates than that needed for soil erosion control (Wilhelm et al. 2007). If soil organic matter content drops and erosion increases, not only will the resource be degraded, but crops will also require increased inputs to maintain productivity. The concern then becomes whether or not crop residue will be removed and, if so, how much will be removed.

Crop residue will be removed and sold only if this practice is profitable. If it is profitable, we must consider the long term conservation benefits of leaving the proper amounts of residue on the field vs. the short term profitability associated with residue sales. Maintaining soil productivity so that long term profitability can be sustained is a strong motive for retaining field residue cover. Unfortunately, leaving the correct amount of residue in the field is a significant challenge when landscape variability requires different amounts of residues be left on different parts of the field. This challenge may be met with advanced harvesting technology. A potentially bigger challenge might present itself when we consider who will make decisions about residue harvest and what benefits they receive for limiting this harvest. It is somewhat clear that the land owner has benefits associated with maintaining soil productivity and therefore has personal financial incentives to limit residue harvest to a sustainable level. The benefits of limited harvest and other conservation practices are less clear, however, for a renter or a land management company whose goal is short term profit, especially in a competitive market with short term leases. Because a large majority of Iowa harvested lands are rented (http://www.nass.usda.gov/

census/census02/volume1/us/st99_2_040_040.pdf) this situation poses a serious concern to soil and water conservation and the sustainability of Iowa farmland.

Changing rainfall patterns create another challenge for soil and water resources. Published science (Groisman et al., 2005) indicates that the frequency of very heavy rainfall events has increased in the Central U.S. by 26% in the last 30 years. Other climate change studies indicate greater future precipitation is likely in the Central U.S. along with greater climate variability (O'Neal et al, 2005). Very heavy rainfalls cause disproportionate amounts of water runoff and soil loss. Maintaining surface protection against these increasingly common heavy rainfalls seems more important today and in the future than ever.

This set of conditions leads us to the following two critical questions. First, do we have the knowledge to identify how much residue can be removed while maintaining long term soil productivity and water quality? And, second, how do we balance the energy needs of the country, financial desires of investors, and the need to conserve the natural resource in the cellulosic biofuels industry? If the cellulosic biofuels industry and natural resources upon which this industry relies are to be sustainable, these questions must be addressed and addressed soon.

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