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Mahdi Al-Kaisi  
*Iowa State University*, malkaisi@iastate.edu

Mark Licht  
*Iowa State University*, lichtma@iastate.edu

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Conservation Systems Role in Sustaining Productivity and Soil Quality

Mahdi Al-Kaisi, Assistant Professor, Agronomy, Iowa State University
Mark Licht, Extension Program Specialist, Agronomy, Iowa State University

Introduction
Conventional tillage can lead to significant increases in soil erosion and deterioration of soil structure, by increasing surface runoff. It is well documented that conservation systems can reduce surface runoff significantly due to crop residue cover and improved soil structure, soil water infiltration, and soil carbon content. The link between conservation systems and soil sustainability and productivity is well documented. The most demonstrated problem associated with the lack of conservation systems in Iowa and elsewhere is the reduction in water quality due to sediment and chemical transport to lakes and streams. The 2004 proposed 303(d) list includes approximately, 211 impaired water bodies in Iowa. Sediment loading constitutes a significant source of water impairments for lakes, rivers, and streams throughout Iowa. However, sediment is not the only non-point source pollutant causing waterbody impairments. In addition to sediment, nitrogen and phosphorus loading are significant contaminants of surface water. Water body impairments due to sediment and nutrient loading can be minimized by shifting to conservation systems.

Conservation Practices
Several conservation practices can be implemented within a comprehensive conservation management system. The following are some prevalent practices that are proven to be effective practices in improving soil and water quality and productivity:

1. No-tillage; no field operations that disturb the soil other than planting. A no-tillage system may include fertilizer application depending on the type and timing of the application. No-tillage can be adopted on any soil type with proper site preparation, especially for poorly drained soils where tile drains are critical. It is highly recommended for well drained soils and highly erodible land.

2. Strip-tillage; a single operation to apply nutrients and prepare a narrow strip to plant into. This system is best suited for use on cool poorly drained and relatively flat soils.

3. Ridge-tillage; ridges are formed to provide seedbed for poorly drained soils. These ridges are formed and maintained during the time of row cultivation.

4. Cover crops; seasonal cover established to provide additional cover off season where crop residue is minimal or removed for other purposes.

5. Grass waterways; grass strips can be established in areas where the natural surface drainage and potential runoff can take place on the field allowing sediments and nutrients to settle out of surface runoff before reaching rivers, lakes, and streams.
6. Buffer strips; are planted on the contour to breakup slope length to act as a filter to slow surface water runoff and allow sediment to settle out.

7. Contour cropping; planting on the contour to slow surface water runoff and sediment loss. This practice is effective in areas of high slope and erodible land.

8. Strip cropping; alternating strips of crops are planted that typically includes an alfalfa strip to provide productive buffer strips within the field to reduce surface water runoff and wind erosion.

9. Extended crop rotations; alternating crops in a planned sequence to provide diversity and crop residue needed for erosion control and improving the soil condition.

**Preparing for the Conservation Security Program (CSP)**

Implementing a strong, comprehensive conservation system early is the key to becoming eligible for the conservation security program (CSP). The CSP is a voluntary program designed to reward farmers who have implemented conservation practices at different levels and continue to have the commitment for such practices. Among the risks associated with conventional tillage, such as increased soil erosion, lost of productivity, and increased input costs, producers can also miss out the opportunity to qualify for the CSP. Farming practices are evaluated based on the potential to improve soil and water quality. With additional CSP watersheds expected to be announced, producers should pay close attention to their tillage practices. Producers who decide to till ground run the serious risk of jeopardizing their eligibility for the program this year and in future years.

**Productivity and Profitability**

A long-term study comparing different tillage and crop rotation systems across Iowa showed that no-tillage corn and soybean yields were competitive with moldboard plowing, deep-rip, chisel plowing, and ridge tillage for more than 8 years after no-tillage was established (Al-Kaisi and Yin, 2004; Yin and Al-Kaisi, 2004). No-tillage typically yielded 5 percent less, especially in poorly drained areas compared to other tillage systems. However, the economic return of different tillage systems showed no-tillage had an advantage over other tillage systems due to the lower cost input with no-tillage (Al-Kaisi and Yin, 2004; Yin and Al-Kaisi, 2004). In a more recent tillage study from eight locations across Iowa, no-tillage corn and soybean yields generally were not significantly different (Al-Kaisi, 2005). This is encouraging for producers who are reluctant to switch to no-tillage due to concerns of poor crop performance. An effective no-tillage system is dependent on properly selecting and setting up the planter to the fertility program to the drainage system. The success of any conservation system depends heavily on how the system is managed.

**Benefits of Conservation Systems**

- Erosion and water quality: Surface residues from both corn and soybean provide protection from both wind and water erosion. Cover crops following soybean and corn silage harvest can be used to increase the amount of residue cover and stabilize the surface soil. Additionally, waterways, terraces, and buffer strips provide living protection that controls the flow of surface water runoff and allow for sediments and nutrients to settle out before leaving the field.
• Crop residue: The more intensive a tillage pass is, the more residue will be broken down and buried. Crop residue is important to hold surface soil in place and protect the soil surface from raindrop and wind impacts. Crop residue also helps hold snowfall in place, which in the spring will contribute to subsurface soil moisture.

• Carbon storage: Not only to intensive tillage operations bury surface residue, but they also aerate the soil to the depth of tillage. Aerating the soil increases the rate of soil carbon decomposition and emission of carbon dioxide. Soil carbon is beneficial to improve soil structure and nutrient and water holding capacity.

• Soil structure: Tillage operations break soil aggregates and decrease pore spaces that are responsible for enhancing water infiltration. By switching to conservation tillage and using cover crops the soil will build better soil structure due to less soil disturbance and increased soil organic matter.

• Soil compaction: There is a misconception of increased soil compaction with conservation systems. Research shows, fields under conservation systems have much better developed soil structure and pore spaces than conventional systems. The improved soil strength allows soil to better standup against heavy field equipment.

• Soil moisture: A major benefits of conservation systems is the enhancement of subsurface soil moisture due to improvement of soil organic matter and water holding capacity. This is critical in areas where precipitation is limited and conservation of soil moisture is a priority.

• Input costs: Generally, conservation systems require less input costs. The advantage of conservation systems is in the fuel saving, where no-tillage generally requires one gal per acre compared to 4.1 gal per acre for conventional tillage operations. The reduction in the number of implements and horsepower needed is also a significant savings in capital and maintenance costs. Fewer trips across the field reduces the fuel and labor needed.

**Resources**

**Web Resources**

Iowa Learning Farm; http://www.extension.iastate.edu/ilf

Soil Management and Conservation Systems; http://extension.agron.iastate.edu/soilmgmt

ISU Agronomy Extension; http://extension.agron.iastate.edu

Iowa Department of Agriculture and Land Stewardship; http://www.agriculture.state.ia.us

Iowa NRCS; http://www ia.nrcs.usda.gov

Iowa DNR; http://www.iowadnr.com

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References

