

Staff Analysis of KEC Background Report
Energy Use in the Kansas Agricultural Sector
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Introduction

Agriculture consumes energy both *directly* as fuel or electricity to power farm activities and *indirectly* in the fertilizers and chemicals produced off-farm. In 2002 (the latest data available), direct energy consumption in the U.S. agricultural sector comprised only 1.1 percent of the 98 quadrillion BTU's of total direct energy consumed in the U.S. Indirect energy consumption by agriculture was about 0.6 quadrillion BTU's. Clearly, changes in agricultural energy use will have only a limited impact on the nation's overall energy consumption.

Nonetheless, at the farm level, energy costs are significant. From 2002 to 2003, energy expenses accounted for nearly 15 percent of total production expenses (roughly 5.2 percent direct and 9.3 percent indirect use). Also, the relative impact of energy costs varies greatly by production activity, amounting to 23 percent of crop production expenses compared with only 6 percent of livestock production expenses.

Agricultural output has generally risen faster than agricultural energy use. In 1999, U.S. agriculture was about 10 percent more efficient in terms of indirect energy usage than it was in 1965, and about 40 percent more efficient in terms of direct energy usage. Much of this improved efficiency is related to higher crop yields and improved machinery operational efficiency.

Here in Kansas, agriculture plays a significant role in the State economy. In 2003, agricultural activity (viewed broadly to include such value-added activities as the meat-packing industry) accounted for 9.2 percent of the state's value-added income and 11.7 percent of total Kansas employment.

Increasing Energy Prices and No-till Farming

Clearly, changes in energy prices can have significant implications for the profitability of Kansas agriculture and can also affect the mix of output and management practices. The June 2006 report on energy use in the agricultural sector prepared by Kansas State University (Kastens et al., 2006) highlighted the potential energy savings associated with the adoption of no-till technology.

Fuel costs per harvested acre on no-till farms are about 67 to 75 percent of those associated with continuous or reduced tillage. Currently, 7 million of the state's estimated 30 million acres of cropland are under no-till practices. No-till is estimated to reduce fuel usage by about 2 gallons per acre (compared with competing tillage systems), saving about \$4.50 per acre (if diesel is valued at \$2.25 a gallon). If all 23 million acres (currently not under no-till) were converted to no-till, fuel usage would decrease by 46 million gallons annually, valued at \$103.5 million.

No-till substitutes herbicides for tillage in order to kill weeds. Concerns about increased pesticide use with no-till can be addressed by incorporating more field buffer strips, herbicide use timing, alternative crops and other production modifications. Research shows that farmers practicing no-till leave greater amounts of carbon in the soil, which maintains soil health and productivity. No-till practices are also beneficial for watershed health due to reduction in erosion from the land and increased rainfall infiltration. Overall, no-till acres in Kansas are currently sequestering about 2.8 million tons of CO₂ per year.

Declining glyphosate herbicide prices and rising diesel fuel prices are likely to encourage more farmers to shift to no-till farming practices. In addition to the reduced fuel usage, and consequent savings, increased adoption of no-till would also provide benefits with respect to carbon sequestration.

Even with these benefits, it will be challenging to realize large increases in this practice over the next several years. The rate of conversion to no-till since 1990 has been relatively slow in Kansas, as in the rest of the midwestern states.

While reduced fuel costs may be anticipated, the decision to adopt reduced tillage practices typically is made because it allows production from additional acres without hiring additional labor. Also, no-till might allow for double cropping where two crops are harvested from the same field in one growing season.

Crops that mature late in the growing season are most adaptable to no-till because evaporation is normally highest in the summer. Thus, the crop residue-based reduction in evaporation associated with no-till production generally provides the greatest benefit to crops planted in the spring.

Expanding the Scope of Existing Conservation Programs

Numerous federal and state programs exist to promote soil conservation, protection of water quality, flood management, and other objectives (see Appendix 1). Many of these programs promote farming practices such as no-till that also result in energy savings and carbon sequestration.¹ However, these additional benefits are rarely mentioned in the program literature. A good example is the federal Conservation Reserve Program (CRP) that provides rental payments to producers to safeguard fragile soils by planting vegetation to (1) control soil erosion, (2) improve water quality, and (3) enhance wildlife habitat. While the three stated goals are being met, carbon is being sequestered and energy conserved.

¹ Carbon sequestration is basically the process of transforming carbon dioxide currently in the atmosphere into soil carbon (organic matter) stored in the soil. Atmospheric carbon dioxide is taken up by plants through photosynthesis. As plants die, the carbon-based leaves, stems and roots decay in the soil and become organic matter. Kansas is estimated to have lost half of the soil carbon originally stored in the soil since the onset of cultivated agriculture in the state. Merely turning over native prairie to plant crops released huge amounts of carbon dioxide into the atmosphere. Kansas soils had a native soil organic carbon content ranging from 1 to 4 percent. Most Kansas cultivated soils now have soil organic content of 0.5 to 2 percent. Nationwide, an estimated 20 to 40 percent of targeted emission reductions can be met by enhancing the condition of land cover that already sequesters carbon, converting additional land to high carbon sequestration uses, and incorporating additional management practices that provide multiple benefits, including carbon sequestration.

In 2004 the State initiated a watershed-based management strategy, the Kansas Watershed Restoration and Protection Strategy (KS-WRAPs) to develop an integrated approach to conservation planning and management that provides a mechanism to organize, promote, and implement conservation programs on the basis of watershed plans. By expanding the scope of KS-WRAPs, this existing program can effectively achieve the objective of promoting no-till farming. Specifically, the program needs to be expanded in the following ways:

1. The additional benefits of carbon sequestration and energy conservation need to be emphasized in desired KS-WRAPs goals;
2. Linkages between KS-WRAPs projects and energy carbon trading programs² need to be established to create a financial incentive for converting to no-till;
3. Information needs to be provided to producers through the KS-WRAPs program demonstrating energy and cost savings associated with no-till agriculture;
4. Land scheduled to come out of the CRP program should be targeted by KS-WRAPs projects as opportunities for no-till.

Under the KS-WRAPs program, local entities develop plans to address watershed conditions and concerns, which in turn guide establishment of goals and objectives to restore watersheds to a more properly functioning condition. Implementation of these goals and objectives is largely accomplished through programs and practices administered by the above referenced agencies and organizations. As Appendix 1 indicates, many management practices funded by these programs also have the potential to reduce energy use and to improve landscape opportunities for carbon sequestration. Of the 33 existing programs summarized in Appendix 1, 28 promote carbon sequestration and 13 have additional benefits in reducing energy consumption. Clearly, the mechanisms are in place to achieve these additional benefits without the creation of any additional program. With a more strategic focus and promotion of these practices in the agricultural sector, enhanced benefits can be obtained.

About 94 percent of the state's land is used for crop and livestock production and wildlife habitat, which presents significant opportunities for carbon sequestration in Kansas. Table 1 illustrates many recommended practices for on-farm energy conservation and their intersection with practices documented to increase carbon sequestration.

² An incentive to encourage producers and landowners to adopt beneficial practices for carbon sequestration is the emerging Carbon Credit Market. In 2005, producers in most of Kansas were able to enroll in a carbon credit pilot project offered by the Chicago Climate Exchange (CCX) and administered by the Iowa Farm Bureau. In the eastern half of Kansas, land in continuous no-till (or strip-till or ridge-till) and new grass plantings is eligible. In western Kansas, only land in new grass plantings is eligible at this time, although this may change as the eligibility requirements are reviewed by the CCX. During 2005, 72 producers in Kansas enrolled more than 75,000 acres in the first phase of the program, primarily no-till producers in the eastern half of Kansas.

Table 1—Relationship between on-farm energy conservation and carbon sequestration practices.

Farm Management Energy Conservation Practices	Documented Effective Carbon Sequestration Practices										
	No-till	Improve Forage Quality	Prescribed Burning	Reduce Overgrazing	Buffer Strips	High Carbon Crops	Grass Plantings	Crop Intensity	Tree Planting	Erosion Control	Cover Crops
Residue Management	X	X	X	X						X	X
Nutrient Management	X	X			X	X					
Crop rotation	X					X		X			X
Irrigation timing								X		X	X
Integrated Pest Management			X	X				X			X
Perennial Plant Cover	X	X	X	X	X		X		X	X	X
Rotational Grazing		X	X	X			X			X	X
Wind and Shelter Breaks					X		X		X	X	

Overview of Several Existing Conservation Programs in Kansas

As Appendix 1 illustrates, the primary natural resource assistance programs in Kansas are administered by the United States Department of Agriculture, Natural Resource Conservation Service, (USDA/NRCS), the Farm Service Agency (FSA), and the State Conservation Commission (SCC).

Conservation Reserve Program—The Conservation Reserve Program (CRP) began in 1986 as part of the 1985 Farm Bill. Its purpose is to remove marginal and highly erodible land from crop production and convert it to perennial native grass cover. Cost share and rental agreement contracts are offered to landowners to establish the grass cover and to offset the income lost from taking the land out of production. Rental payments are based on the Environmental Benefits Index (EBI). To determine the EBI, FSA collected data based on the relative environmental benefits for the land offered for contract. Generally, the environmental benefits data collected covered wildlife, water quality, erosion, enduring benefits, and air quality.

As of June 2006, Kansas has 3,109,599 acres enrolled in the CRP program. On September 30, 2006, 19,616 contract acres will expire. An additional 1,610,265 acres will expire on September 30, 2007. Certain contracts that expire starting between September 30, 2007, and September 30, 2010, will be eligible for re-enrollment or contract extensions. The breakdown of the new contracts and extensions is summarized in Table 2.

Table 2—Summary of CRP New Contracts and Extensions in Kansas.

	Expiring	2-year extension offer	3-year extension offer	4-year extension offer	5-year extension offer	10-year re-enrollment offer	15-year re-enrollment offer
Number of Acres	1,610,265.1	410,827.1	469,606.3	317,799.9	260,161.5	151,236.4	633.9
Number of Contracts	17,803	4,796	5,195	3,779	2,473	1,552	8

These 1.6 million acres of expiring CRP land represent significant carbon sequestration benefits, in addition to those benefits used to calculate the EBI. It is expected that a number of those offered the 2-year and 3-year extensions will not accept the extension, and these acres, which total 880,433 (or 54% of the total acres expiring), will either be grazed or broken out for farming again. If the acres are grazed, the sequestration benefits could be retained through good management practices outlined in Appendix 1 and Table 1. However, if the acres are converted to cropland again, many of these benefits will be lost unless a significant number of acres are cropped using no-till residue management and other beneficial practices. These producers/landowners should be encouraged to either keep the land in CRP or adopt management practices that will maximize energy reduction, carbon sequestration and natural resource concerns.

Conservation Reserve Enhancement Program—Another program that would result in energy savings is the Upper Arkansas River Conservation Reserve Enhancement Program (CREP) that is proposed to begin in 2007. CREP is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. In Kansas, the program is designed to reduce water shortages along the Arkansas River by providing financial incentives to enroll irrigated acres and retire the associated water rights. The majority of irrigation draws from the High Plains and alluvial aquifers.

The Upper Arkansas River CREP proposes to enroll up to 100,000 acres into the program. Cropland, most of it irrigated (85,000 acres) would be converted to grassland over a period of two years. Up to two years of limited irrigation would be allowed, to establish grass; afterwards the irrigation pivots would be removed and the land maintained as grassland while enrolled in CREP. If successful, this program would reduce energy consumption from an average of 59,850 kWh to less than 5,000 kWh per pivot for the first two years on pivots enrolled in the CREP. In subsequent years, energy consumption will be reduced to zero, as the pivots will be removed from the enrolled parcel. Total energy savings for the term of the CREP contracts (up to 15 years) will approach 40 million kWh.

While the primary purpose of this program is to conserve groundwater, secondary benefits include energy conservation and improvement in watershed function. These complementary benefits also accrue through many other programs already in place at both the state and federal levels.

USDA/NRCS Programs—Appendix 1 summarizes the programs offered by the USDA/NRCS in natural resource management that may also result in energy conservation and carbon sequestration. From 2003 to 2005, landowners voluntarily participated in practices that covered 2,738,383 acres for a total of \$89,450,041 in cost-share dollars. Of these acres, the Conservation Security Program (CSP) accounted for 760,656 acres. The CSP requires a comprehensive evaluation of the entire producer operation and encourages beneficial management practices in all activities. Practices included in the Environmental Quality Incentive Program (EQIP), which also encourages good management practices, accounted for 1,034,988 acres. In 2006, over 7,000 irrigated acres contracted to transition to dryland cropping for at least four years, through EQIP's Ground and Surface Water "quick response areas" in the High Plains aquifer (NRCS 2003 Annual Reports).

SCC Programs— Appendix 1 summarizes the programs offered by the SCC. From 2004 through the first half of 2006, a total of \$12,972,721 was spent on these programs. The nonpoint source program accounted for 5,213 acres protected and the Water Resources Program accounted for 124,615 acres protected. The Critical Area Planting practice protected 1430 acres and is estimated to have saved 21,809 tons of soil. The pasture/hayland improvement practice protected 8,543 acres and is estimated to have saved 33,000 tons of soil. The range planting practice protected 7,929 acres and is estimated to have saved 40,675 tons of soil.

Other Programs— Appendix 1 lists additional agencies that offer cost-share programs and practices for resource management. While the majority of the funding comes through NRCS and SCC, these other programs can address niche projects or leverage funding for larger projects.

Tools for Assessing Alternative Management Practices in Agriculture

Several tools are available to producers for evaluation of the programs and management practices that would be most effective in reducing energy use while providing natural resource benefits (including water quality and habitat improvement, carbon sequestration) and maintaining productive use of the land.

The CSP offered by the NRCS encourages high levels of natural resource conservation and provides a financial incentive to eligible producers to conduct an Energy Audit, an assessment of how energy is being consumed with suggestions for reducing energy use and producing alternative energy. The NRCS also promotes Resource Management Plans for farms and ranches, which comprehensively evaluate practices in the operation to optimize production while minimizing natural resource impacts. Many recommended management practices to enhance natural resource protection may also result in energy conservation and carbon sequestration. Farm-A-Syst is a similar tool available from K-State Research and Extension.

The tools described above are designed for site-by-site evaluation. The recently developed framework for Kansas Watershed Restoration and Protection Strategy (KS-WRAPS) development takes these tools a step further by promoting resource assessments on a watershed basis. Through this process, watershed conditions and needs can be more comprehensively addressed. Funding is available through the KS-WRAPS program to assess watershed conditions and develop implementation plans with specific actions to address whole watershed

needs. This program offers additional potential for incorporating energy reduction and carbon sequestration opportunities in the landscape in general and in agricultural practices specifically.

Strategic application of available funds will increase the effectiveness of existing programs. For example, if acres in CRP contracts are subject to being broken out into farmland and these acres are identified through the KS-WRAPS assessment process as critical to meeting or maintaining watershed goals, increased targeting to work with specific landowners can be done to either maintain the acres in CRP or encourage management practices on the cropped or grazed land that maximize energy savings, carbon sequestration, and overall watershed function.

Summary

Energy conservation in the agricultural sector will probably not play a large role in reducing energy use overall in Kansas. However, agricultural practices, when implemented in a comprehensive resource management strategy, can buffer the effects of energy use in other sectors. Through the programs and practices discussed above, agricultural producers have opportunities to participate in cost-share programs designed to benefit natural resources, including carbon sequestration, while also reducing energy costs and consumption. An urgent need exists to work with producers that have CRP contracts expiring in 2007. Encouragement and assistance should be targeted to these producers to maintain land in grass or adopt no-till management if cropped. An effort should be made to increase the total acres of no-till in the state to assist in aggregating credits to be applied in the carbon credit program.

State and Federal cost-share dollars are available for many practices that contribute to energy reduction and carbon sequestration in addition to addressing natural resource concerns for which they were originally developed. The agricultural sector can benefit significantly from these programs by utilizing the assessment tools and programs already in existence.

Enhanced coordination of existing programs has the potential to reduce energy consumption, improve resource management and watershed health, positively impact global warming, and provide additional income to producers

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Appendix 1—Energy and Carbon Sequestration Benefits of Agricultural Natural Resource Management Programs

Although reducing energy use in the agricultural sector may have only a small impact on greenhouse gas emissions, the manner in which agriculture is conducted can play a significant role in buffering the effects of fossil-fuel-based energy consumption by other sectors as the state and world transition to other forms of energy. By focusing on management practices that (1) reduce energy consumption, (2) have the potential to sequester carbon, and (3) address natural resource concerns, producers can improve their bottom line and contribute to reducing greenhouse gases and global warming. This indirect but significant impact on energy use issues provides an opportunity for agriculture in Kansas.

Many existing government programs provide financial incentives on hundreds of practices. Although these programs were primarily developed to address other natural resource concerns, agricultural producers can use these programs to reduce energy use and enhance carbon sequestration while protecting other natural resources. Table 1 summarizes these programs and their benefits.

Summary of Resource Management Programs and Management Practices to Enhance Carbon Sequestration (1 = Improve Forage Quality, 2 = Prescribed Burning, 3 = Reduce Overgrazing, 4 = Buffer Strips, 5 = High Carbon Storage Crops, 6 = No-till and Reduced Till, 7 = Grass Plantings, 8 = Increase Cropping Intensity, 9 = Tree Plantings, 10 = Erosion Control, 11 = Cover Crops).

Agency	Program	Purpose	Energy Conservation and Carbon Sequestration Potential	Relevant Management Practices (see above)
Health and Environment	Nonpoint Source Pollution	Provides funds for projects that will reduce sources of nonpoint source pollution or that treat nonpoint source pollution before it reaches receiving water	Practices may reduce energy consumption through reduced water supply treatment needs. Projects may result in opportunities for C sequestration and provide multiple benefits	1 - 11

USDA/NRCS	Conservation Compliance	Requires specific treatment of highly erodible cropland and wetlands in order participate in most USDA programs	Practices may reduce energy consumption through reduced water supply treatment needs. Projects may result in C sequestration and provide multiple benefits. Watershed function improvement.	1 – 11
	Conservation Operations	Provides technical assistance on private lands for development and application of Resource Management Plans	Practices may reduce energy consumption through reduced water supply treatment needs. Projects may result in opportunities for C sequestration and provide multiple benefits.	1 - 11
	Environmental Quality Incentives Program	Offers financial and technical assistance to install structural and management practices	Practices may reduce energy consumption through reduced water supply treatment needs. Projects may result in C sequestration and provide multiple benefits. Watershed function improvement.	1 - 11
	Inventory and Monitoring	Provides information on soils, water and related resources. Conducts a national survey every five years.	Assists in tracking and quantifying land uses and conversions	1 - 11
	Plant Materials Program	Assists with development of plant materials and techniques for their use in environmental improvement programs	Opportunities to develop high carbon sequestration potential plants.	1, 5, 7, 8, 9, 10, 11
	Watershed Planning and Operations	Provides assistance to watershed or conservation districts to install treatment and structural practices	Practices may reduce energy consumption through reduced water supply treatment needs	4, 10
	Ground and Surface Water Conservation	Facilitates a conservation measure that results in a net savings in ground or surface water resources in the agricultural operation of a producer	Water conservation and energy use reduction	

	Wetlands Reserve Program	Cost share and easements to restore and protect wetlands	Reduces flood damage, filters pollutants, and reduces soil erosion, supplies wildlife habitat. Watershed function improvement and C sequestration	4, 7, 9, 10
	Wildlife Habitat Incentives Program	Cost share to establish wildlife habitat	Watershed function improvement and C sequestration	1, 3, 4, 7, 9, 10
	Grassland Reserve Program	Cost share and easements to protect, restore, and enhance native rangeland	Watershed function improvement and C sequestration	1, 2, 3, 7, 10
	Grazing Lands Conservation Initiative	Enhances the state's privately-owned grazing lands by increasing technical assistance at the grassroots level	Healthy grazing lands result in reduced runoff and nonpoint source pollution while sequestering carbon	1, 2, 3, 5, 7, 10
	Conservation Security Program	Contract payments for utilizing beneficial conservation practices. CSP is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life on Tribal and private working lands	Reduces soil erosion, improves water quality, water conservation. Watershed function improvement and C sequestration. Opportunities for energy use reduction.	1 – 11
	Conservation Reserve Enhancement Program	A voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water	Reduces energy use. Reduces soil erosion, improves water quality, water conservation. Watershed function improvement and C sequestration	1, 2, 3, 4, 7, 9, 10, 11
	Farm and Ranchland Protection Program	Provides funding to keep farm and ranchlands in agricultural uses	Watershed function improvement and multiple C sequestration	1 - 11
	Energy Audits	Assessment of how energy is being consumed and suggestion on how reductions can be made and alternative energy produced	Energy use reduction and alternate energy sources	

Farm Services Agency	Conservation Reserve Program	Cost share and rental agreements to convert marginal cropland to native grasses and wetlands	Preserve the function of these systems and may enhance C sequestration. Energy conservation	1, 2, 3, 4, 7, 9, 10, 11
US Fish and Wildlife Service	Fish and Wildlife Enhancement Program	Supports field operations which includes technical assistance on protecting, restoring or maintaining native habitats	Preserves the function of these systems and may enhance C sequestration	1, 2, 3, 7, 9, 10, 11
	Private Lands Program	Contracts for 1 to 29 years to restore, enhance or create wetlands or native grasslands.	Preserves the function of these systems and may enhance C sequestration	1, 2, 3, 4, 7, 9, 10, 11
Wildlife and Parks	Conservation Easements for Riparian and Wetland Areas	Establishes easements to permanently secure and enhance quality areas in the state	Preserves the function of these systems and has potential for C sequestration	4, 7, 9, 10, 11
	Wildlife Habitat Improvement Program	Provides limited assistance for development of wildlife habitat	Watershed function improvement and C sequestration	1, 3, 4, 7, 9, 10
	North American Waterfowl Conservation Act	Provides up to 50% cost share for purchase and/or development of wetlands and wildlife habitat	Watershed function improvement and C sequestration	4, 7, 9, 10, 11
	Wildtrust	Accepts donated money, property and real estate to acquire and protect sensitive habitat	Watershed function improvement and C sequestration	2, 4, 7, 9, 10, 11
	MARSH Program	May provide up to 100% of funding for small wetland projects. Projects need to provide waterfowl benefits and be open to the public	Watershed function improvement and C sequestration	4, 7, 9, 10, 11
State Conservation Commission	Water Resources Cost Share Program	Provides state financial assistance to landowners for the establishment of enduring water conservation practices to protect and improve the quality and quantity of Kansas Water Resources	Reduces soil erosion, improves water quality, water conservation. Watershed function improvement and C sequestration	1 – 11

	Nonpoint Source Pollution Control Fund	Provides state financial assistance for nonpoint source pollution control practices for the protection or restoration of surface and groundwater quality	Protects and/or restores surface and ground water quality. Watershed function improvement and C sequestration. Practices may reduce energy consumption through reduced water supply treatment needs.	1 – 11
	Riparian and Wetland Program	Addresses the conservation and management of riparian areas and wetlands.	Reduces flood damage, filters pollutants, reduces soil erosion, supplies wildlife habitat. Watershed function improvement and C sequestration	4, 7, 9, 10
	Water Rights Purchase Program	Provides financial assistance to a local entity to purchase a water right to restore base flows in designated streams and/or slow or reverse the decline of groundwater levels in specific aquifers	Water and energy conservation	
	Water Quality Buffer Initiative	State cost share incentives supplement federal incentives to encourage the establishment of riparian forest buffers and vegetative filter strips.	Watershed function improvement and C sequestration	4, 7, 9, 10
Kansas Forest Service	Conservation Tree Planting Program	Provides low cost trees and shrubs for conservation plantings	Watershed function improvement and C sequestration	4, 9, 10
	Riparian and Wetland Program	Promotes and assists with establishment of riparian forest land and wetlands	Watershed function improvement and C sequestration	4, 7, 9, 10

Kansas Rural Center	River Friendly Farms Program	Producers may qualify for a \$250 incentive payment for completing the RFFP assessment and action plan. Upon Completion, producers may be eligible to apply for up to \$5,000 in cost share funds	May identify opportunities for energy use reduction. Watershed function improvement and C sequestration	1 – 11
Kansas Alliance for Wetlands and Streams	Wetland and Riparian Program	Provides financial assistance for water education statewide. Financial and technical assistance for construction of streambank restoration and wetland projects.	Watershed function improvement and C sequestration	4, 7, 9, 10, 11