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MILESTONE REPORT

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Executive Summary (Period between 4/23/2009 and 10/22/2009)

The project has gotten off to a good start and has been able to initiate research plantings of biomass crops on schedule. Work on measuring and valuing potential environmental services is continuous as well as the research into potential markets for those environmental services. The team working on the Life Cycle Assessment (LCA) continues to gather background data on the KODA facility and the perennial cropping systems. Following is brief summary by objective (see list of objectives on page2): 1) Plantings of biomass crops have been established using different planting dates to determine the impact of planting dates on production. The first measurements of productivity have been taken on those plantings. Secondary data is being reviewed to estimate costs and benefits that will be supplemented by project data; 2) initial measurements of wildlife impacts have started in coordination with other projects and we are reporting results of the impact of perennials on water quantity and quality coming off of catchments with perennial crops and restored wetlands. We are seeing good results in terms of nitrogen and sediment reduction but less impact on phosphorous primarily because of residual phosphorous in the system; 3) we have distributed a survey to the public to gauge their interest in different environmental benefits and will be gathering and analyzing that data as those surveys are returned; 4) we have initiated the planning for a review of markets for environmental services in the US and internationally that might provide insight into how such markets might be implemented in Minnesota; and 5) our LCA team has begun gathering the necessary data for the Life Cycle Assessment and planning that activity. The one area where we are delayed is in applying ash from the KODA energy facility to perennial cropping systems. KODA has run into technical difficulties procuring and feeding grasses into their system but that is being worked out..

The project goal is to develop an efficient system for the production, pre-processing and delivery of biomass feedstocks for energy production that minimizes feedstock cost for energy facilities while maximizing landowner income and the environmental benefits of biomass production.

The project objectives are:

- Establish, research cultural practices, and estimate costs and potential cost savings for the establishment, management, pre-processing and transport of perennial biomass feedstocks from field to energy facility.
- Estimate potential energy, wildlife, water quality, carbon and soil health benefits from targeted perennial biomass feedstock plantings.
- Value environmental benefits for potential payments to landowners who provide environmental commodities.
- Complete an integrated assessment of multiple ecological services markets currently being used; identify potential buyers of ecological services provided by perennial biomass energy crops; develop an integrated ecological services payment package.
- Develop a model for the production, pre-processing and delivery of perennial biomass feedstocks to energy facilities including a life-cycle assessment of the system from field to facility.

Technical Progress:

I. Biomass crop production field to farm gate

This series of activities will help us understand issues in producing biomass crops on farm from planting through harvesting. Since many of the crops being considered for biomass production, and especially some of the native prairie species have not been produced commercially knowledge of production is limited to what is known about reestablishing prairies but not with commercial production in mind. We need to understand how to produce these new crops and how to manage them throughout the growing season through harvest. The objective of Research Area I is to develop guidelines for production of biomass that can be provided to farmers.

Note: A more detailed description of the plots is included in the Milestone 1 report.

Experiment 1: Establishment strategies for weed control

Objectives: Develop new approaches for weed control in establishing native perennial grasses and grass-forb polycultures. (Weed control is one of the more costly operations in establishing the biomass crops and cost control during the establishment phase of the biomass crops will be important in keeping costs low and improving the financial viability of biomass production from perennial crops.)

Treatments: whole plot treatments are native plant species: 1) Switchgrass grown alone, 2) a native grass tertiary mixture of switchgrass, big bluestem, and indiangrass, and 3) a mixture of switchgrass, big bluestem and indiangrass with eight forbs.

Subplot treatments: winter rye; spring oat, and barley companion crops, herbicides for weed control, and mowing for weed control. The subplots are nested in the whole plots and are set up to use 1) companion crops; 2) herbicides; or 3) mowing for weed control. A companion crop is planted along with the 3 native plant configurations to determine if the companion crop is effective in suppressing weeds without having a significant impact on survival and growth of the native(s). The second weed control treatment is the use of herbicides and the third treatment is mowing to control weeds in the native plantings. This will allow us to compare the effectiveness and relative costs of each weed control method.

The experiment was established and the following data collected:

1) Plant populations for all treatments were collected in the year of seeding by counting all plants in a 3 ft² area. Extremely dry conditions from June to August reduced establishment of all treatments and resulted in native plant populations of less than 2 plants per ft². Subplot treatments had no significant effects on plant populations ($P>0.05$).

2) Biomass yield of oat and barley companion crops was measured at the boot stage (pre flowering) and averaged 6 ton/acre while biomass yield of a winter rye companion crop seeded in the spring harvested at the same time was 2 ton/acre. Yields of pure stands of native grass monocultures and mixtures taken in the fall were limited by the poor populations and the lack of rainfall; biomass yields were less than 1 ton per acre. Natives seeded with companion crops did not regrow and were not harvested in the fall.

In 2010, additional population and biomass yield data will be collected.

Experiment 2: Optimum planting dates for native perennial crops

Objectives: Determine the effect of planting date on the establishment of native perennial grasses and grass-forb polycultures.

Treatments: Whole plot treatments are native plant species: 1) Switchgrass grown alone, 2) a native grass tertiary mixture of switchgrass, big bluestem, and indiangrass, and 3) a mixture of switchgrass, big bluestem and indiangrass with four native forbs and four native legumes.

Subplot treatments within the whole plots were three dates of seeding: Early December before snowfall; January-March; and June. This is a similar layout to Experiment 1 in which large plots are established with the grass and and grass and forb mixtures are planted on a large plot. Within that plot the planting dates were varied to understand the impact of the planting date on crop characteristics.

The experiment was conducted and the following data collected:

Broadcast seeding occurring in December, March, and June. In July, plant population data was collected.

Overall, broadcast seeding of all treatments resulted in poor stands relative to what is expected with spring seeding. Populations for December and March seedings averaged about 1 plant ft² while populations for the June seeding averaged about 5 plants ft². Establishment of all treatments was limited by competition with annual weeds in the spring. No biomass yields were collected in Fall 2009 due to poor populations, low potential yields and high weed populations.

Experiment 3: Optimum harvest dates

(Experiment 3 will be reported on in the Milestone 3 report.)

Experiment 4: Fertilizer replacement value of biofuel ash

Objective: The overall objective is to answer fundamental questions related to the agronomic use and potential environmental impacts of ash generated from combustion of herbaceous native perennial biomass at the Rahr Malting facilities.

Accomplishment/update:

All research on ash evaluation is delayed because the Koda Power facility is not burning native grasses. We are re-evaluating this experiment and may suggest an alternate scenario that would allow us to initiate the experiment using ash from current Koda operations transitioning to ash from herbaceous native perennial biomass once that becomes available.

II. Moving biomass from road/farm gate to facility

This will be undertaken by Koda Energy, will be initiated prior to project start date, and will not require Xcel Energy RDF funding as this is part of their commercial operations. Information from Koda Energy will be incorporated into the Life Cycle Assessment and progress on this area will be reported in future milestone reports.

As the project continues we will be incorporating the Koda Energy information into our overall analysis and that information will be reported on as it is incorporated into the Life Cycle Assessment and as part of our supply chain analysis. Koda is exploring different options for handling the needed supply for their biomass facility. They will be using a percentage of grasses and prairie mixes but are now considering a greater use of woody biomass. Our project, through other funding sources is also exploring dedicated woody crops as well as brushland harvest as part of prairie maintenance operations by the DNR and other organizations. We will be able to include that information in our analysis to the extent that information becomes available from our other research and other sources before the end of the project.

Another important issue that is being explored by Koda is the staging of the biomass supply. Because of limited available storage on site at the facility, Koda is considering establishing a site for gathering and preprocessing biomass that would then be moved to the facility. This is another area we will be able to report on as the project progresses.

III. Measure and value environmental benefits

In this area we will measure and evaluate the specific impacts of biomass crops on the environment including: 1) changes in gamebird populations on areas planted and managed for biomass feedstocks; 2) changes in water quality parameters (turbidity, sediment, nitrogen and phosphorus concentrations); 3) register values reflected in emerging ecosystem markets for water quality and carbon and others as they emerge such as biodiversity; and 4) preparation of a life cycle assessment which allows us to estimate environmental impacts associated with the production, harvest and combustion of biomass crops including an evaluation of resource use and emissions as the crops are produced, transported and combusted.

A. Wildlife impacts

Overview of 2009 Accomplishments

Using project funding obtained from the Legislative and Citizen's Commission on Minnesota Resources (LCCMR) and the National Fish and Wildlife Federation (NFWF), we conducted surveys on 20-acre (approx. 8 ha) plots located near Crookston (16 plots), Morris (19 plots), and Windom (28 plots). These same methods and protocols will be used for surveying sites near Shakopee starting with the 2011 growing season. Each plot was surveyed twice using an area-based search method that covered the entire plot (Johnson and Igl 1995). Many birds, especially sparrows, were detected primarily by their songs, but blackbirds and bobolinks were detected by both sight and sound. Plots were surveyed in 2009 (pre-harvest data) and will be surveyed in 2010 (post-harvest). 2009 data have been summarized below.

Ten species of birds were sufficiently abundant to allow for statistical analysis of factors affecting their abundance (asterisks in the far right column indicate statistically significant regional variation in bird abundance):

Species	Crookston	Morris	Windom	
Bobolink	4.34	10.70	3.31	
Sedge Wren	0.75	5.25	1.45	
Savannah Sparrow	5.06	0.98	0.86	*
Red-winged	0.56	2.10	4.19	*
Common	0.50	2.53	3.05	*
Clay-colored Sparrow	1.31	1.83	0.45	
Grasshopper Sparrow	1.28	0.53	1.14	
Swamp Sparrow	0.03	0.25	0.81	*
Brown-headed	0.00	0.43	0.48	
Song Sparrow	0.06	0.13	0.40	*
Total birds	13.91	24.70	16.14	
Number of sites	16	19	28	

Data from all species were subject to pronounced variation among sites (i.e., there were high sampling variances), which precluded what seem like large regional differences in abundance from being statistically significant (see for example Bobolinks, with nearly 3-fold variation in mean abundance between Windom and Morris). We will analyze data using zero-inflated negative binomial regression, which will help to account for some of this excess variation.

We found little evidence of other “nuisance factors” influencing bird counts. Counts were unaffected by number of observers, timing of surveys (calendar date, or starting time after sunrise) or local weather conditions (temperature or wind speed), indicating that our survey protocols were well designed to capture true variation in bird abundance and not influenced by variation in observer skills or other factors influencing the likelihood of seeing or hearing birds.

Planned Activities for 2010

Gamebird surveys will be repeated in the spring of 2010 through project funding outside of this grant but will also provide data relevant to the impact of perennial crops on wildlife. Data will be generated from project plantings once those plantings are established in the last two years of the project.

B. Water quality assessment – Begin monitoring watershed

Overview of 2009 Accomplishments

Hydrologic and water quality monitoring of four watersheds (referred to as the Kittleson/SHEEK watersheds) with different vegetative cover conditions continued through summer and early fall of 2009 in Martin County. Comparisons are being made among watersheds with differing percentages of perennial crops (grasses and woody vegetation that could potentially be used as biofuels) with restored wetlands and subwatersheds that are largely corn-soybean crops that represent current land use practices. The 2009 data add to the data collected over the past four field runoff seasons (roughly April through October). Total rainfall and rainfall intensity was measured using three standard rain gauges and two tipping bucket gauges. Additionally, nutrients (SRP, Total P, ortho-P, NO₃-NO₂) and suspended solids (TSS, SVS) were monitored by collecting grab samples every 1-2 weeks or by using automated samplers during peak flow events.

Results of the 2005-2008 data are summarized in a masters' thesis by Greg Fransen, titled "Hydrologic, nutrient, and sediment responses of restored perennial vegetation/wetland complexes in southern Minnesota" which is currently undergoing final editing. Nitrate loading from upland corn-soybean farming systems is significantly reduced by the perennial vegetation/wetland complex in the Kittleson watershed. Effects on phosphorus export are less encouraging, because of high levels of residual phosphorus in the agricultural soils on which perennial crops and wetlands were established. The 2009 nitrogen and phosphorus data show similar results, although phosphorus export appears to be diminishing; these data will be examined with 2010 data to determine if phosphorus export is being reduced over time as perennial vegetation and wetlands mature.

Planned Activities for 2009-2010

Monitoring will continue on all project sites parallel to analysis of data from the field sites.

C. Integrated assessment of ecological service markets

Overview of 2009 Accomplishments

The Ecological Services Team continues to meet as needed. To date the team has accomplished the following:

- IATP market assessment: Report scoping and staff assignment; began initial research on operating environmental service markets in Europe and US, including current pricing systems, type and range of buyers; available supply and cost to producers; etc.
- Rural Advantage working with researchers at the University of Minnesota has prepared and distributed a survey of consumers interest in a variety of environmental services and is preparing a review of existing programs which pay for environmental services. Results of the survey and the review of existing programs will be reported in the Milestone 3 report.
- Rural Advantage has prepared an initial market survey of markets for ecological services and that has been included as an appendix to this report.

Planned Activities for 2009-2010

Continue research as described above, as well as beginning next steps of initial identification of local regional purchasers and type of services that would be of most interest/availability.

D. Life cycle assessment

Overview of 2009 Accomplishments

The Life Cycle Assessment Team in the Department of Bioproducts and Biosystems Engineering have published data on the life cycle inventory of the life cycle of switchgrass electricity. Of the life cycle of biomass electricity within our initial system boundary, the key processes identified are cultivation, harvest, transportation to power plants, biomass electricity generation at Koda Energy's facility and exports of excess heat and electricity to Rahr Malting and Xcel Energy. Life Cycle Inventory data for all upstream emissions of input products used in switchgrass cultivation and harvest are compiled from previous studies. We have developed a plan to gather life cycle process-specific inventory data including energy use, resource, inputs materials and emissions associated with production of the farm inputs.

Planned Activities for 2009-2010

The LCA team will continue to gather information for the analysis and coordinate with other project researchers to ensure that the data generated by other research areas meets their needs for the LCA analysis.

IV. Economic assessment of biomass production and delivery system

This research area looks at the financial and economic aspects of biomass production from the perspective of the landowner/farmer who may be interested in producing biomass feedstocks for the market and also the value of the environmental services (water quality, recreation, carbon) to society both qualitatively and quantitatively.

A. Cost Benefit Analysis – Plan activities and begin data collection

Overview of 2009 Accomplishments

We continue to review secondary sources of data on the production of biomass from perennial crops, particularly grasses. In September 2009 through supplemental funding, we were able to sponsor a demonstration of a “biomass baler” that can be used on brushlands that could potentially provide an additional source of woody biomass to KODA Energy. Detailed data was taken on productivity of the baler and the costs of fuel and time required to produce bales on 9 different sites in Minnesota. Summary data on the biobaler demonstration will be included in Milestone Report 3.

Planned Activities for 2009-2010

We will continue to gather data on:

- Costs of establishment
- Costs of maintenance of plantings (fertilization, weed control, etc.)
- Cost of harvest
- Transport costs (this will be done in coordination with KODA energy)

This information will be integrated with the data being developed through the planting and cultivation experiments.

B. Valuation of ecological services

Overview of 2009 Accomplishments

This will be done in coordination with **IIIC** above. Results from **IIIC** will be used to help determine how the public values ecological services which will allow us to use those values for our analysis. In addition to the information gathered through the survey, we will be gathering data on the emerging markets for carbon and water quality credits. Linda Meschke is involved in a USDA Conservation Innovation Grant project which is studying payments for environmental services in the Minnesota River Basin and Dr. Bill Easter and Dr. Dean Current on our team continue to serve on the National Advisory Committee for that project which will provide another source of information for this work.

Planned Activities for 2009-2010

We will continue gathering data on existing options for payments for environmental services as well as new initiatives. This information will be combined with the data generated through the survey instrument.

Project Status: The project continues to meet the timeline with some minor delays but with good progress in most areas. The ash fertilization task continues to be delayed due to the lack of ash from grasses from the KODA energy facility. We are working with KODA and other partners to resolve this issue and expect to complete this task before the end of the project.

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V. Appendix 1 – Initial Market Assessment of Markets for Ecological Services.

Development of an Ecological Payment Package [ECoPayPack] Program

A Review of Existing Programs

Prepared by:

Rural Advantage

May 20th, 2009

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Traditionally, conservation and environmental stewardship have been ancillary issues relevant to maintaining production capacity or to achieve federal agricultural policy goals. As a result, farmers and ranchers seriously underperform in providing the ecological services society wants and is willing to pay for. The reasons for this underperformance are many and complex, from federal farm policy to local land use decisions, but are universally recognized as being economic in nature. Simply put, because producers are not paid for the ecological services they provide little incentive exists for farmers and ranchers to improve conservation and environmental stewardship so that ecological services can be maximized and the multiple benefits sustainable agriculture has the capacity to provide are realized.

Payments for ecological services, whether it be water quality trading, species mitigation banks, or carbon sequestration; are quickly growing as a market based solution to environmental degradation concerns. While the potential for capitalizing on these new markets is real, the opportunities are currently limited, or in early stages of development.

This paper serves to identify some existing programs domestically and internationally being used to address payments for ecological services in the following areas:

- Carbon
- Greenspace
- Biodiversity
 - Wildlife habitat
 - Pollinator habitat
- Water quality
 - Phosphorous
 - Nitrogen
- Aquifer recharge/water storage
- “Bundled Services”

Carbon –Chicago Climate Exchange (CCX)

The Chicago Climate Exchange (CCX) is the market that is currently available to farmers and ranchers in the United States. It is organized as a cap-and-trade scheme where a cap is placed on emissions and participants are required, through voluntary yet legally binding agreements, to meet their prescribed cap by reducing emissions directly, through offset credits, or a combination of the two.

Offsets are tradable credits generated by implementing mitigation projects in sectors not covered by the emissions cap.¹ Project types approved for generating offsets include:

- Ag/livestock methane
- Coal mine methane
- Landfill methane
- Ag soil carbon
 - No-till
 - Grassland planting
- Rangeland soil carbon management
- Forestry
- Renewable Energy

Chicago Climate Exchange (CCX) covered Green House Gases (GHG's)

- carbon dioxide (CO₂)
- methane (CH₄)
- nitrous oxide (N₂O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulfur hexafluoride (SF₆)

- Ozone depleting substance destruction

Farmers can choose practices to implement on their farms to generate credits to sell as offsets on the CCX. The trading of credits is restricted to those entities with at least 10,000 metric tons of CO₂e to trade. Generators of smaller blocks of credits like farmers and ranchers work with aggregators who pool credits and then sell them in large 10,000 metric ton blocks annually.

More information can be found at <http://www.chicagoclimatex.com/>

National Farmers Union – Carbon Credit Program²

The National Farmers Union Carbon Credit Program pays farmers, ranchers, and landowners to sequester carbon through management practices. The process begins by determining the practice the landowner wants to undertake. Practices and their credit generating rates are below:³

- **No-till** - Carbon credits are issued at the rate of 0.2 to 0.6 metric tons of carbon per acre annually to participants who commit to continuous conservation tillage on enrolled land for at least five (5) future years. In most cases, credit can be earned for the previous year. Enrolled acres may be planted in low residue crops (i.e. beans, peas, lentils) no more than three of the contract years. Alfalfa or other hayed forage will be considered as no-till for these contracts.
- **Seeded grass** - Carbon credits are earned at a rate of 0.4-1.0 metric tons per acre annually, even if enrolled in CRP. Grass stands seeded prior to January 1, 1999, are not eligible for enrollment in the program. Credits can be earned back to 2003 with proper documentation.
- **Forestry** - New trees planted after 1990, can earn carbon credits annually, provided no harvest is intended.
- **Livestock methane⁴** - Methane captured and/or destroyed can earn carbon credit. Animal waste systems, including anaerobic digesters and covered lagoons, can be enrolled. Each ton of methane captured earns 21 tons of carbon credits.

After implementing the carbon sequestering practice producers can apply for carbon credits through the National Farmers Union (NFU). They host a web-based system where producers register, create an account, update their fields with the practice they are doing, and generate a contract. This contract is signed by the producer and mailed to the NFU along with several supporting documents. Each program is slightly different but most programs eligible to producers in the Midwest have the same base set of documents NFU will need as part of the application. Those documents include:⁵

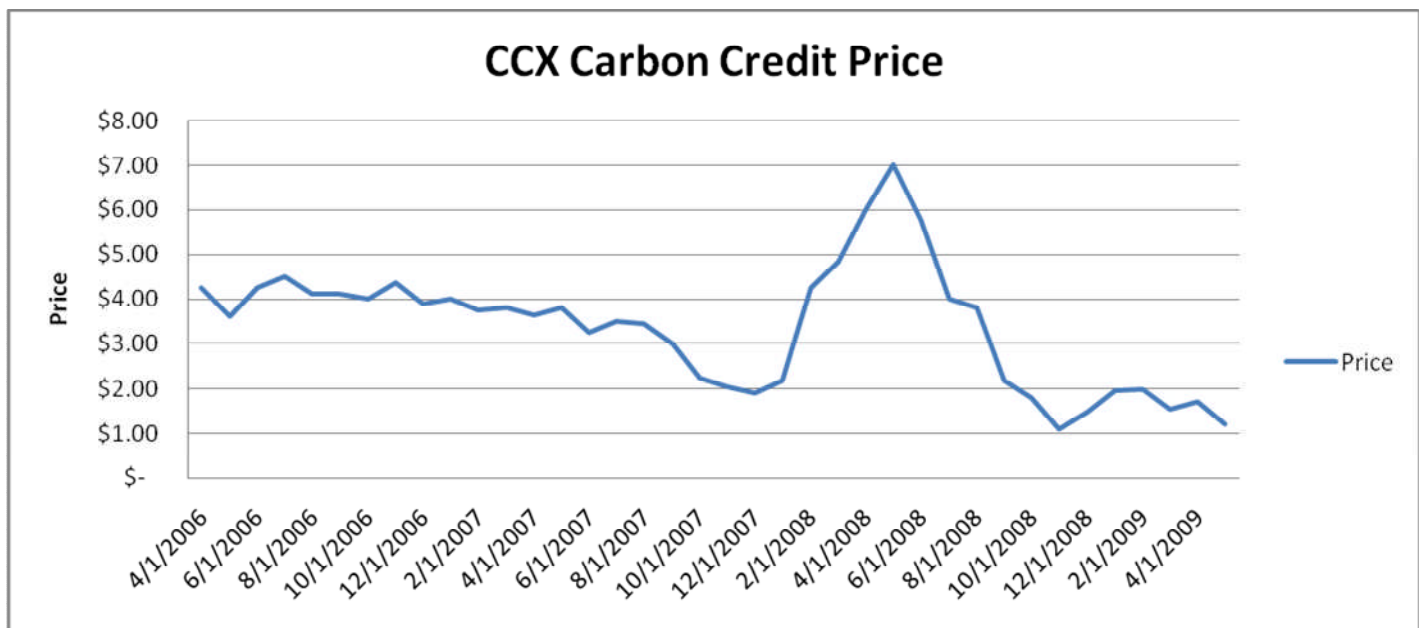
- Most recent FSA Form 578 Report of Commodities (Farm and Tract Detail Listing) for all acres enrolled.
- Most recent FSA Form 578 Report of Commodities (Farm Summary) for all farms enrolled.
- Most recent Aerial Maps for all parcels enrolled. Maps must be originals or clear copies

Maps MUST be marked with:

- Farm and Tract numbers
- Acres in each tract
- Legal Description of mapped areas

Once NFU receives the paperwork they work with a 3rd party verifier to inspect the parcel and ensure compliance. As part of the contract, producers are required to periodically complete a project report that is sent to the Chicago Climate Exchange to verify compliance. After the initial verification of the land parcel, credits are “released” and are approved for sale.

Although contracts are for 5 years, sales of credits happen annually, typically in the spring or summer when demand is highest. Aggregator fees and CCX fees are deducted from the gross and 20% of each year’s sales are held back in a reserve pool to ensure excess credits are available for compliance issues; the rest is paid out to the contract holder. The 20% that is held back annually in the reserve pool is paid out as one lump sum payment at the end of the contract.⁶



More information can be found at <http://carboncredit.ndfu.org/> or by contacting NFU at 701-952-6156

AgraGate: Climate Credits Corporation⁷

AgraGate is the self proclaimed “country elevator” of the carbon credit marketplace pooling carbon credits from eligible projects and selling them on the CCX. The eligible practices and credit generation rates are the same CCX practices and rates used by NFU. Producers interested in generating carbon credits for sale on the CCX follow a similar protocol as the NFU program. AgraGate carbon credits generated on cropland are called Exchange Soil Offsets (XSO’s). Documents needed for submission of the XSO contract include:⁸

1. Signed and dated Exchange Soil Offset (XSO) Contract
2. Completed Exchange Soil Offset Worksheet(s)
3. Copies of the FSA maps highlighting the eligible acres
4. Copies of FSA 578 reports of eligible acres
5. If applicable, documentation of new grass acres (i.e., croppable land converted from cropland to grass after January 1, 1999.)
 - a. CRP, CREP, and WRP acres:

- i. Provide copies of CRP, CREP, and/or WRP contracts for the eligible acres
 - ii. Provide copies of FSA 578 form for the year prior to starting the CRP, CREP, or WRP contract
- b. Other (not CRP, CREP, and WRP acres):
 - i. Provide copies of receipts for seed, fertilizer, etc.
- 6. A voided check from your checking account
 - a. This allows us to electronically transfer funds directly into your checking account

Practices are inspected through an independent 3rd party verifier. Credits are put up for sale annually and the same standard fees and reserve requirements apply as with the NFU program.

More information can be found at <http://www.agragate.com/> or by contacting AgraGate at 1-800-633-6758

Carbon –European Union Emissions Trading Scheme (ETS)⁹

The European Union Emissions Trading Scheme (UE ETS) was developed to assist EU members in reaching their carbon reduction commitments of the Kyoto Protocol. It works by placing a cap on emissions from each member state commensurate with their pledged reductions as outlined in Kyoto. Each member state then develops a national allocation plan (NAP) to determine the total number of emission allowances granted to individual businesses and companies. Those businesses that maintain their emissions levels below their allocated allowances can sell any excess credits. Likewise any business exceeding their allocation must reduce their emissions to below their allocation or purchase credits from those that have excess to sell. Companies may trade directly with each other, through trading platforms, via brokers or banks, or any other market intermediary.

An electronic registry contains all allowances for each member state and is connected to a larger system EU wide that monitors each transaction to ensure compliance of the rules. Each company that has a reduction requirement as well as any person, company, or other entity looking to buy or sell allowances must have an account with the registry.

More than 10,000 installations are covered under the scheme and range from combustion plants to oil refineries to iron and steel plants to pulp and paper manufacturers. The emissions allocations companies received through national allocation plans in the first phase (2005-2007) were mostly given away for free. Some member states have developed auctions for use in the second phase (2008-2012) but by and large most allocations will again be given away free of charge to companies.¹⁰ Rule changes will require auctions for most all allowances in the 3rd phase and where undue hardship exists, allowances may still be given away but in limited amounts and only after benchmarking has been completed. Monitoring and reporting of emissions is crucial to accurately administer the cap. Companies are required to report annually on actual emissions and have those reports verified by independent 3rd party verifiers.

The EU ETS only includes point sources of GHG emissions and within that context still leaves some industries out. For example, aluminum and chemical manufacturing as well as the transportation sectors are not included in the system; although it should be noted that airline transportation is being included in the second phase (08' – 12').¹¹ Because only point sources are included agriculture as a sector is not able to participate.

The EU ETS is a regulatory market where heavy emitters are required to participate. This does several things. First it increases the number of participants in the market thus adding to liquidity. Second, because most of the heavy emitting sectors are included it has the capacity to lead to actual reductions of GHG's vs. shifting of

emission to other sectors. Finally, the regulatory framework works to provide a level of certainty going forward so that business and industry can plan for future growth all while reducing emissions.

A final note that warrants mentioning is the price for carbon allowances. The price for allowances in the European market has traditionally been much higher than that of the Chicago Climate Exchange. This has many reasons ranging from a regulated market where virtually all heavy emitters are included driving demand for allowances to economic conditions and weather which has an impact on energy demand and thus carbon emissions. What is interesting to note is the precipitous decline in carbon prices at the end of the first phase of the ETS. This drop is primarily attributed to an over allocation of allowances to emitters that significantly curbed demand and thus a reduction in price. A voluntary market, like that currently used in the United States that does not include some of the heaviest emitters will continue to be plagued by this same scenario; low demand and thus low prices for carbon allowances.

Greenspace – Dakota County Farmland & Natural Areas Protection Program¹²

Greenspace is a somewhat encompassing term that can include parks, golf courses, greenways, forests, farmland, and greenbelts. Within the context of this report greenspace refers to greenways & farmland. Farmland refers to acres used for raising crops. These acres can range in quality from prime soil/highly productive areas to marginal or environmentally sensitive areas. Acres used for haying or grazing would also be included in farmland.

Dakota County is part of the Minneapolis/St. Paul (Twin Cities) Metropolitan complex. It is a fast growing county and is projected to continue growing, leading to even more developmental pressures. Citizens concern with losses of farmland and natural areas led to planning efforts in the late 90's and early 2000's to develop and implement a protection plan specifically for farmland and natural areas within the county. Findings of the plan include:¹³

- Approx. 2000-3000 acres of farmland are converted to houses each year in the County
- Only 2% - 3% of the County's original natural areas remain
- 80% - 90% of the wetlands in the County of been drained or filled
- Each year over 3,000 housing units are added to the County
- Over 50% of responding citizen surveys reveal an interest in protecting farmland and over 90% for protecting natural areas\

The program works by paying farmers for the development value of their acres in exchange for a permanent conservation easement that allows the land to be farmed but restricts development. A few of the eligibility requirements and key points of the program include:⁴

- Acres must be locally zoned and planned for agriculture, as well as regionally planned for agriculture
- Majority of parcel must be classified as agricultural, and part of Metro Ag Preserve Program
- 75% of acres in agricultural use within parcel must be class 1 or 2 soils(highly productive)

- Property must be at least 40 acres and at least half of that must be in ag use
- Some portion of property must be within ½ mile of rivers and streams as directed in the Resource Inventory Map developed for the project, or be adjacent to already enrolled and protected land
- Conservation easements are permanent and transferred to all future owners
- Public access is not a requirement but are prioritized in selection criteria
- Conservation management plan must be in place that requires 150' buffers for stream corridors

To date the program has protected 3,512 acres of farmland through 28 permanent easements at a total acquisition cost of \$16.7 million. Dakota County estimates their actual costs to protect these farmland acres at over \$6.5 million.⁵

More information can be found at:

<http://www.co.dakota.mn.us/CountyGovernment/Projects/FarmlandNaturalArea/default.htm> or by contacting Al Singer, Land Conservation Manager for Dakota County @ 952-891-7001

Biodiversity – Wildlife Habitat – Gopher Tortoise

The world is losing habitat at an alarming rate and with it the species that depend on that habitat. The Millennium Ecosystem Assessment,¹⁵ a project of the United Nations between 2001 and 2005, reports that 10-30% of mammal, bird, and amphibian species are currently threatened with extinction and that the leading cause of biodiversity loss is habitat destruction. Closer to home, the United States has 571 animal species listed as endangered or threatened and another 746 species of plants that also meet the definition of endangered or threatened.¹⁶

To combat this loss of habitat and species the Endangered Species Act (ESA) of 1973 gave regulatory authority to protect endangered or threatened species to the U.S. Fish and Wildlife Service (US FWS) through listing of species. Once an endangered or threatened species is listed, habitat protection, restoration, and enhancement become priorities to conserve the species. The market opportunity that arises from the regulatory authority of the ESA is conservation banking.

Conservation banking, often called species banking, has its origins in wetland banking whereby negative impacts to wetlands are required to be mitigated through mechanisms that result in no net loss of wetlands and the functions they provide. Similarly, conservation banking mitigates the loss of species that are listed as endangered or threatened by restricting the taking of listed species as well as preservation of habitat the species relies on. In theory this results in no net loss of species.

The US FWS defines a conservation bank as a parcel of land containing natural resource values that are conserved and managed in perpetuity, through a conservation easement held by an entity responsible for enforcing the terms of the easement, for specified listed species and used to offset impacts occurring elsewhere to the same resource values on non-bank lands.¹⁷ The bank earns credits for acres of habitat, actual numbers of species, breeding pairs, or some other approved parameter. These credits can then be sold to public institutions

Natural Area Conservation Easement²

Natural Area Conservation Easements are permanent voluntary agreements that give the holder the right to prevent certain uses (e.g. residential development, mining, erecting structures). The landowner retains all remaining rights to use their property and the parcel remains on the local tax rolls.

Pros:

- Landowner retains property right
- Property stays on the local tax rolls
- Permanent protection of natural areas
- Achieves permanent protection without the added cost of actual ownership
- With development rights retired taxes are typically less

Cons:

- Many landowners are unfamiliar with conservation easements and how they work
- Public access on privately held

or private businesses planning development nearby (on non-bank lands) that would impact a listed species. The conservation easement restricts certain types of activities and is accompanied by a management plan to ensure high quality habitat for the species in perpetuity. Typically a state institution or non-profit is the holder of the easement to ensure long term care and management for the parcel.

Because conservation banking is specific to a listed species virtually every conservation bank will be unique. However, to streamline the conservation banking process the U.S. FWS has developed supporting material and policy considerations on the guidance for the establishment, use, and operation of conservation banks.

One such conservation bank was set up by the Mobile Area Water and Sewer System to protect the threatened Gopher Tortoise, a unique turtle that gets its name from the burrows that it digs as its home. The burrow offers protection from the elements, predators, and keeps the cold blooded turtle comfortable. These burrows range in size from 6-20 ft long and 3-15 ft deep. A gopher tortoise will dig and live in several different burrows throughout its range. What makes the gopher tortoise so important is that the burrows it digs are home to many other species; from snakes, frogs, and fox to mice, lizards, skunks to name a few. Thus population declines of this long lived tortoise affect an array of other species as well.

The Gopher Tortoise is closely associated with the longleaf pine habitat. As this habitat is lost and further fragmented gopher tortoise populations continue to decline. The turtle is listed as a threatened species. In the Mobile county area of Alabama development has resulted in fragmentation of habitat and some loss of habitat. In an effort to protect the species and provide for further development, the Mobile Area Water and Sewer System worked with the US FWS to develop a Gopher Tortoise Recovery Plan that made provisions for conservation banking as a mechanism to use in protecting habitat for the continued survival of the turtle. Two hundred twenty two acres of undeveloped land around Lake Converse, consisting of prime longleaf pine habitat, has been designated and approved by the US FWS as a conservation bank for the gopher tortoise.¹⁸

The Endangered Species Act (ESA) protects endangered or threatened species by prohibiting the hunting, harming, harassing, capture, collection, or modification of habitat. It further instructs U.S. Federal agencies to protect species by consulting with the US FWS before authorizing, funding, or carrying out activities that could harm a listed species.¹⁹ In practice this means private landowners needing a sewage disposal system permit are required to consult with the US FWS to determine if the action will cause harm to the gopher tortoise.

If harm or modification of habitat is found, the landowner will be required to apply for an incidental take permit to move the tortoise. An incidental take permit requires the development of a habitat conservation plan (HCP). An alternative is to request a certificate of inclusion from the Mobile Area Water and Sewer System Board to relocate the tortoise to the conservation bank they established around Lake Converse. In this scenario the Board has already taken the necessary steps and developed a HCP for the conservation bank so that all the private landowner needs to do is request a certificate of inclusion to be part of the conservation bank.

Private landowners choosing to request a certificate of inclusion to the conservation bank follow these steps:²⁰

1. Private property owners will have their property surveyed for gopher tortoises and make the determination that their actions will result in a take to gopher tortoise(s). The property owner will provide the Service with a vicinity map showing the location of the property, the planned development and the location of each burrow.
2. The Service will review the request to determine eligibility for inclusion in the Conservation Bank. If the proposal is appropriate, based on guidance in the Habitat Conservation Plan ("HCP"), the Service will inspect the site, verify that the proposal fits the guidelines for inclusion and coordinate the proposal with the regional archaeologist for National Historic Preservation Act compliance.

3. The Service will furnish the applicant with the Board's contact. At that point, a mitigation fee will be set by the Board based on the number of tortoises.
4. The Board will sign the Certificate of Inclusion after the mitigation fees are paid. The original copy of the certification will be sent to the Service via mail and a copy will be faxed to the Service.
5. The Service's Daphne Field Office will sign the Certificate of Inclusion and arrange for the relocation of tortoise(s) to the Conservation Bank. The Service will be responsible for trapping the tortoise on the private property and will agree to accomplish trapping within 60 days of the request. NOTE: In the event the property owner cannot wait for the Service to trap the tortoise, the property owner may elect to enlist a qualified biologist to trap or excavate the tortoise at the owner's expense.
6. The Service will be responsible for testing the tortoise(s) for URTD's ("Upper Respiratory Tract Disease"), to include drawing blood from the tortoise(s), sending the samples to the testing laboratory in Gainesville, FL, holding the tortoise(s) until test results are received, marking the tortoise(s), and relocating the tortoise(s) into a suitable burrow at the conservation bank site.
7. The Board will be responsible for all habitat management activities set forth in the HCP to include prescribed burning, cogon grass treatment, regeneration activities, site preparation, flagging of burrows, herbicide application, establishment of fire lanes a minimum distance of 25 feet from burrows, and adaptive management activities set forth in the HCP.
8. The Service will be responsible for monitoring of gopher tortoises at the Conservation Bank in order to evaluate the progress of the plan in establishing a self-sustaining gopher tortoise population as follows:
 - a. All resident tortoises will be affixed with radio transmitters to monitor dispersion rates. The tortoises will be located twice a year for 2 years.
 - b. Twenty-five translocated tortoises will be affixed with radio transmitters and will be located daily for the first week following relocation, weekly during the subsequent 4 weeks, and then twice during each of the following 2 years; once in the summer and once in the winter. For each tortoise, data will be collected regarding presence of the tortoise on the Conservation Bank and, if located, distance from the release site. This data will be analyzed to compare emigration from and movement within the Conservation Bank of both resident and translocated tortoises. The data will also be analyzed as to differing emigration and movement patterns for male and female tortoises.
9. The Board will conduct a survey every 2 years for active and inactive burrows following prescribed burns to establish population trends at the Conservation Bank. This will be done until year 10 of the bank's existence. Note will be made of juvenile burrows, and egg fragments on burrow aprons as indicators of post-relocation reproductive status.
10. The Board will annually measure pine and hardwood basal area, canopy cover, and herbaceous ground cover at the Conservation Bank and will annually estimate the number of acres impacted by cogon grass. A report will be made to the Service including the relationship between stand basal area, canopy cover, and herbaceous ground cover.
11. The Service will test 10% of the tortoise population at the Conservation Bank for URTD every two years until the Board has sold all of the available Certificates of Inclusion.

12. The Board will prepare an annual report to the Service containing information on the incidental take authorized under the HCP during the preceding year, number of translocations, and restoration and management activities at the Conservation Bank as described in the HCP.

13. The Scientific Advisory Panel will meet at least once annually in person or by conference call for 10 years to review the results of the monitoring program and to participate in the adaptive management framework described in the HCP.

The cost to the private landowner for the certificate of inclusion (credit) for relocating one gopher tortoise is \$3,500

Biodiversity – Pollinator Habitat

About three-quarters of the more than 240,000 species of the world's flowering plants rely on pollinators—insects, birds, bats, and other animals—to various degrees to carry pollen from the male to the female parts of flowers for reproduction. Pollinators are vital to agriculture because most fruit, vegetable, seed crops and other crops that provide fiber, drugs and fuel are pollinated by animals. Bee-pollinated forage and hay crops, such as alfalfa and clover, also are used to feed the animals that supply meat and dairy products. Animal-pollinated crops generally provide relatively high income to growers than do crops pollinated in other ways. Over and above its direct economic value to humans, pollination by animals provides essential maintenance of the structure and function of a wide range of natural communities in North America, and it enhances aesthetic, recreational, and cultural aspects of human activity.²¹ The connection between healthy pollinators and healthy ecosystems is overwhelming. This, coupled with the mysterious Colony Collapse Disorder (CCD) has triggered a renewed interest in protecting both native and managed pollinators.

Within the context of managed pollination, honeybee hive owners are paid, typically by large growers of a particular crop, to bring their bees to the crop orchard or field and leave them there through the end of flowering. In this way honeybee owners are getting paid for the ecological service of pollination the bees are accomplishing. Within the context of native pollination, the same function is being provided by native insects, birds, etc. to the crop without any monetary expenditure. That does not include the value to non-crop plants that need pollination for reproduction. Thus a major focus is on maintaining the capacity of native pollinators.

The United States Department of Agriculture (USDA), through the Natural Resources Conservation Service (NRCS), provides several programs that can be used to provide habitat (nesting cover) as well as diverse food sources, and pesticide protection for native pollinators.²²

Pollinator requirements and the conservation practices that can be used to provide them in the field		
Pollinator Resource	NRCS Code and Conservation Practice	
Forage – Diverse sources of pollen and nectar that support pollinators from early in the spring to late in the fall	311 – Alley Cropping	322—Channel Bank Vegetation
	327—Conservation Cover	328—Conservation Crop Rotation
	656—Constructed Wetland	332—Contour Buffer Strips
	340—Cover Crop	342—Critical Area Planting
	386—Field Border	393—Filter Strip
	412—Grassed Waterway	422—Hedgerow Planting
	603—Herbaceous Wind Barriers	379—Multi-Story Cropping
	512—Pasture and Hay Planting	595—Pest Management
	409—Prescribed Forestry	528—Prescribed Grazing
	550—Range Planting	391—Riparian Forest Buffer
	390—Riparian Herbaceous Cover	381—Silvopasture Establishment

	585—Stripcropping	612—Tree/Shrub Establishment
	601—Vegetative Barriers	659—Wetland Enhancement
	657—Wetland Restoration	580—Streambank and Shoreline Protection
	645—Upland Wildlife Habitat Management	644—Wetland Wildlife Habitat Management
	380—Windbreak/Shelterbelt Establishment	650—Windbreak/Shelterbelt Renovation
	643—Restoration and Management of Rare and Declining Habitats	
	395—Stream Habitat Improvement and Management	
Nest Sites – stable ground, holes in wood, cavities for bumble bees, or overwintering sites for bumble bee queens	322—Channel Bank Vegetation	656—Constructed Wetland
	332—Contour Buffer Strips	342—Critical Area Planting
	386—Field Border	422—Hedgerow Planting
	409—Prescribed Forestry	391—Riparian Forest Buffer
	612—Tree/Shrub Establishment	659—Wetland Enhancement
	657—Wetland Restoration	645—Upland Wildlife Habitat Management
	650—Windbreak/Shelterbelt Renovation	380—Windbreak/Shelterbelt Establishment
	644—Wetland Wildlife Habitat Management	
	329—Residue and Tillage Management, No-Till/Strip Till/Direct Seed	
Pesticide protection - refuge from spray, buffers to drift, etc.	322—Channel Bank Vegetation	656—Constructed Wetland
	342—Critical Area Planting	422—Hedgerow Planting
	391—Riparian Forest Buffer	657—Wetland Restoration
	380—Windbreak/Shelterbelt Establishment	
Site management for pollinators	595—Pest Management	338—Prescribed Burning
	409—Prescribed Forestry	528—Prescribed Grazing
	645—Upland Wildlife Habitat Management	644—Wetland Wildlife Habitat Management
	647—Early Successional Habitat Development or Management	
	643—Restoration and Management of Rare and Declining Habitats	

Source: NRCS Technical Note No 78

The Conservation Security Program (CSP) is a voluntary conservation program that supports ongoing stewardship of private agricultural lands by providing payments for maintaining and enhancing natural resources. CSP identifies and rewards those farmers and ranchers who are meeting the highest standards of conservation and environmental management on their operations.²³ Through CSP, enhancement payments can be made that address a specific resource. One of the available options is the Pollinator Areas Enhancement Activity which can earn an enhancement payment of \$100/acre. A few requirements and criteria include:

- Pollinator habitat areas must be at least ½ acre in size and include a minimum of 10 flowering plant species which must comprise at least 50% of the seeding rate.
- Only native species can be planted and must include at least three early, three mid, and three late flowering species from the NRCS state list²⁴
- Management and maintenance activities must be conducted outside the growing season or bloom period
- The area will be inspected for function and requires management and maintenance of the activity

The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that provides financial and technical assistance to farmers and ranchers who face threats to soil, water, air, and related natural resources on their land.²⁵ Practice standard 645, upland wildlife habitat management, now offers an option for pollinator habitat management that pays approximately \$10/acre. A wildlife management plan is required for sign-up and the practice is authorized on all eligible 645 acres for up to 120 acres per year per operation, not to

exceed 3 years. To receive the payment the management plan must meet the 645 standard AND the Pollinator guidelines to accomplish season long flowering on the enrolled field. Meeting these requirements will necessitate the use of native plant materials. Cost share dollars are also available for the writing of the wildlife management plan.²⁶

Water Quality - Phosphorous– Great Miami River Watershed Water Quality Credit Trading Program²⁷

The Great Miami River Watershed in southwestern Ohio is home to over 1.5 million people (75% urban), drains an area of nearly 4,000 square miles, and is part of fifteen Ohio counties. Almost 83% of the land in the watershed is agricultural, predominantly row-crop production (corn, soybeans, wheat). The health of the Great Miami River Watershed is important to the ecosystems that it supports.

Water quality impairments in the Great Miami River Watershed are attributed in great part to non-point sources of pollution including sedimentation, excess nutrients in waterways, and habitat alterations. Ag and urban sources of pollution both contribute to the impairment.

In an effort to reduce costs associated with treatment, improve water quality, and provide multiple benefits to the environment, the Water Conservation Sub-district (WCS) of the Miami Conservancy District (MCD) began investigating water quality trading in 2003 beginning with an economic analysis to determine viability. Kieser & Associates was hired to complete the work and a summary of their findings are below:²⁸

- Enough credits can be generated from ag BMP's to cover point source discharge reduction requirements
- With a few exceptions ag BMP's can supply virtually all the phosphorous credits needed and should be able to supply most of the N credits when needed
- Net potential savings of \$305 million to \$376 million using trading vs traditional treatment plant upgrades

Water quality credits are primarily generated by implementing management practices (BMP's) that go above and beyond those required by law. These BMP's must occur upstream of the point source discharge location. This can potentially be detrimental to point source dischargers in the headwaters area of the watershed because they simply can't find ag practices further upstream. In these cases, alternative methods of generating credits other than agricultural BMP's can be used and include an array of practices to reduce urban runoff. Other key components of the program include:

- The program is intended to focus on nutrient loading in the watershed
- Credits can be generated using funds from a variety of sources
 - A credit is equal to a pound of nutrient prevented from entering the rivers and streams of the watershed
 - Cost of a credit is market driven and should be calculated by summing all costs of the credit generating project including all capital outlays and on-going maintenance expenditures and then dividing by the total number of credits
 - The program uses a reverse auction to get the lowest cost of compliance through non-point practices
- Credits are only generated and certified after the practice has been installed and is functioning properly
- The credit generation rate for a particular practice is calculated via a load reduction spreadsheet used by staff of the Ohio EPA and DNR
- A county SWCD is required to be a partner in all credit generating projects

- The program does not dictate which practices or activities to undertake but instead relies on local SWCD's, ag producers, and other professionals to identify and implement nutrient reducing projects
- The SWCD will certify implementation of projects and is also tasked with inspecting management practices & determining on going compliance
- A Management Practice Contingency Plan is required in order to ensure a timely response should a practice fail, fall out of compliance, and cease generating credits for buyers
- An Insurance Pool of credits is used to guarantee credits are always available and in compliance for credit buyers
- Credit buyers (point source dischargers) are public and private wastewater treatment plants
 - They have a state issued National Pollution Discharge Elimination System (NPDES) permit
 - They must modify their NPDES permit to reflect participation in the program
 - They assist funding initial administrative and analytical costs for the trading program
 - Are classified as “investors” if participating prior to NPDES nutrient compliance requirements
 - Are classified as “contributors” if participating to comply with existing compliance requirements
- Trading ratios describe the pounds of nutrient reduced from an upstream management practice in relation to pounds reduced at the actual site of discharge via on-site treatment options
- Trading ratios are used as an incentive for investors to participate prior to compliance requirements as well as a mechanism to differentiate nutrient discharges to attaining waters vs impaired waters

The Great Miami River Watershed Water Quality Trading Program allows for agricultural BMP's to be used to reduce nutrient loading to the watershed and generate credits that can be used by point source dischargers to mitigate costly on-site treatment upgrades. Although the program does not dictate what practices should be used to achieve non-point reductions it should be assumed that the least cost option to the producer will be the practices that are favored both to keep the cost low for the point source credit buyers and to minimize disturbances to the ag producer. Furthermore, the economic analysis conducted by Kieser & Associates, which showed economic viability of the program, was based on three main BMP's:

- conversion from full tillage to no-till,
- nutrient management resulting in 50% reductions of fertilizer for all lands
- conversion from row-crop to perennial hay

Given the large spread between the projected cost to treat point source discharge on-site, especially at lower levels, and the projected cost of implementing BMP's on ag land (\$37 million cost for BMP's vs over \$400 million for on-site treatment) it appears that plenty of potential funding exists to move to a higher level of BMP's beyond the traditional conversion to no-till and nutrient management plans. The rationale for moving to a higher level of BMP's is twofold. First it rewards those producers that have already submitted to some base level of environmental stewardship and allows them to participate with these higher level BMP's. Finally it enhances credibility and integrity of the program because higher level BMP's truly do provide more ecological function on the landscape.

Several aspects of the program are truly innovative and warrant inclusion in other water quality programs being developed throughout the country, they include:

- Use of trading ratios to entice early “investors” into the program to help drive demand
- Requirement of management practices occurring upstream of point source discharge
- Requirement of Management Practice Contingency Plan and Insurance Pool to provide the guarantee to credit buyers that their credits will always keep them in compliant with their NPDES permit
- Credit generation project funds can come from a variety of sources

More information can be found at: http://www.miamiconservancy.org/water/quality_credit.asp or by contacting Dusty Hall, Program Coordinator @ 937-223-1278, ext. 3210

Water Quality - Nitrogen –European Union: Nitrates Directive

The European Union has a heavily directed system of protecting members' waters from harmful nitrates from agricultural sources. The Nitrates Directive was established in 1991 to "reduce water pollution caused or induced by nitrates from agricultural sources and, preventing further such pollution". The directive outlines the following requirements of member states: ²⁹

- Identify surface waters and groundwater affected or liable to be affected by pollution
- Identify vulnerable zones which contribute to pollution
- Establishment of codes of good agricultural practices to be implemented by farmers voluntarily
- Establish and implement action programs for vulnerable zones

Article 4 of the directive requires the establishment of BMP's (called code or codes of good agricultural practices) for all waters, an outreach program for the implementation of the BMP's and reporting requirements about the BMP's effectiveness. BMP's required for each member countries program include but are not limited to:

CODE(S) OF GOOD AGRICULTURAL PRACTICE

A. A code or codes of good agricultural practice with the objective of reducing pollution by nitrates and taking account of conditions in the different regions of the Community should contain provisions covering the following items, in so far as they are relevant:

1. periods when the land application of fertilizer is inappropriate;
2. the land application of fertilizer to steeply sloping ground;
3. the land application of fertilizer to water-saturated, flooded, frozen or snow-covered ground;
4. the conditions for land application of fertilizer near water courses;
5. the capacity and construction of storage vessels for livestock manures, including measures to prevent water pollution by run-off and seepage into the groundwater and surface water of liquids containing livestock manures and effluents from stored plant materials such as silage;
6. procedures for the land application, including rate and uniformity of spreading, of both chemical fertilizer and livestock manure, that will maintain nutrient losses to water at an acceptable level.

B. Member States may also include in their code(s) of good agricultural practices the following items:

7. land use management, including the use of crop rotation systems and the proportion of the land area devoted to permanent crops relative to annual tillage crops;
8. the maintenance of a minimum quantity of vegetation cover during (rainy) periods that will take up the nitrogen from the soil that could otherwise cause nitrate pollution of water;
9. the establishment of fertilizer plans on a farm-by-farm basis and the keeping of records on fertilizer use;
10. the prevention of water pollution from run-off and the downward water movement beyond the reach of crop roots in irrigation systems.

Article 5 of the directive stipulates BMP's in designated vulnerable zones with a corresponding outreach program and reporting requirements. BMP's required for each member countries program include but are not limited to:

MEASURES TO BE INCLUDED IN ACTION PROGRAMMES FOR VULNERABLE ZONES

1. The measures shall include rules relating to:

1. periods when the land application of certain types of fertilizer is prohibited;
2. the capacity of storage vessels for livestock manure; this capacity must exceed that required for storage throughout the longest period during which land application in the vulnerable zone is prohibited, except where it can be demonstrated to the competent authority that any quantity of manure in excess of the actual storage capacity will be disposed of in a manner which will not cause harm to the environment;
3. limitation of the land application of fertilizers, consistent with good agricultural practice and taking into account the characteristics of the vulnerable zone concerned, in particular:

- (a) soil conditions, soil type and slope;
- (b) climatic conditions, rainfall and irrigation;
- (c) land use and agricultural practices, including crop rotation systems;

and to be based on a balance between:

- (i) the foreseeable nitrogen requirements of the crops, and
- (ii) the nitrogen supply to the crops from the soil and from fertilization corresponding to:
 - the amount of nitrogen present in the soil at the moment when the crop starts to use it to a significant degree (outstanding amounts at the end of winter),
 - the supply of nitrogen through the net mineralization of the reserves of organic nitrogen in the soil,
 - additions of nitrogen compounds from livestock manure,
 - additions of nitrogen compounds from chemical and other fertilizers.

2. These measures will ensure that, for each farm or livestock unit, the amount of livestock manure applied to the land each year, including by the animals themselves, shall not exceed a specified amount per hectare.

The specified amount per hectare be the amount of manure containing 170 kg N. However:

- (a) for the first four year action programme Member States may allow an amount of manure containing up to 210 kg N;
- (b) during and after the first four-year action programme, Member States may fix different amounts from those referred to above. These amounts must be fixed so as not to prejudice the achievement of the objectives specified in Article 1 and must be justified on the basis of objectives criteria, for example:

- long growing seasons,
- crops with high nitrogen uptake,
- high net precipitation in the vulnerable zone,
- soils with exceptionally high denitrification capacity.

If a Member State allows a different amount under subparagraph (b), it shall inform the Commission which will examine the justification in accordance with the procedure laid down in Article 9.

3. Member States may calculate the amounts referred to in paragraph 2 on the basis of animal numbers.

4. Member States shall inform the Commission of the manner in which they are applying the provisions of paragraph 2. In the light of the information received, the Commission may, if it considers necessary, make appropriate proposals to the Council in accordance with Article 11.

The BMP's for vulnerable zones are in addition to the BMP's that already apply to all waters of member nations.

Water Storage/Aquifer Recharge– NYC & Catskill/Delaware Watershed Protection Program

The City of New York receives its drinking water from reservoir systems located in upstate watersheds. The US Safe Drinking Water Act stipulates that suppliers of water must filter drinking water or prove watershed protection sufficient enough to ensure drinking water quality standards. The estimated capital cost ranged from \$4 -\$6 billion with estimated annual operations and maintenance costs of \$250 million. Instead of moving forward with the filtration plant, the city decided to invest in upstream watershed protection and apply for a Filtration Avoidance Determination (FAD) waiver from the US Environmental Protection Agency (EPA).

The EPA approved the FAD contingent on implementation of several watershed protection programs listed below.³⁰

- Watershed Land Acquisition
- NYC Watershed Rules and Regulations
- Watershed Ag Program
- WWTP upgrades upstream in the watershed
- New Sewage Treatment Infrastructure
- Reservoir Modeling & TMDLs
- Waterborne Disease Risk Assessment Program
- Stream Management Program
- Kensico Modeling and remediation Program
- Catskill/Delaware Water Supply System UV Disinfection Facilities
- Other Protection Program

Two main programs are used to address non-point source pollution, the land acquisition program and the watershed ag program.

The watershed land acquisition program (LAP) is a key component of New York City's comprehensive efforts to protect and enhance the quality of its water supply. Land acquisition and proper stewardship can protect natural resources that filter pollutants before they reach reservoirs. Acquisition of sensitive areas near watercourses, whether through outright purchase or through conservation easements, can prevent the introduction of new sources of pollution. The program works by offering fee simple or conservation easements from the City. A supplementary program developed for farmers was established in partnership with the Watershed Agricultural Council (WAC), through which farm easements are acquired by WAC. Both types of easements allow landowners retain ownership and certain productive and recreational uses of the land.³¹

Through the LAP the City of New York acquires either fee title to land or conservation easement. Landowners are paid fair market value. Acres are targeted to priority protection areas. NYC is committed to spend \$250 million in Delaware/Catskill watershed, of which \$10 million is dedicated to agricultural easements for producers who have a Whole Farm Plans.

The watershed agricultural program (WAP) is a comprehensive effort to develop and implement pollution prevention plans on 85% of the commercial farms in the Catskill and Delaware watersheds. It's a voluntary partnership between the City and farmers to reduce nonpoint—indirect—sources of agricultural pollution. Funded by the City, the Program is administered by the not-for-profit Watershed Agricultural Council (WAC), whose board consists of farmers, agri-business representatives and the DEP Commissioner.³²

The WAP is administered by the Watershed Agricultural Council (WAC). WAC is a non-profit organization with the mission to support the economic viability of agriculture and forestry through the protection of water quality and the promotion of land conservation in the New York City watershed region.³³

The program uses whole farm planning to identify, prioritize, and address environmental concerns on farms. Farmers first sign a voluntary participation agreement with WAC. A planning and implementation team, comprised of conservation professionals, visits the farm to identify and assess potential sources of pollutants, using a custom Environmental Review/Problem Diagnostics tool. The team then reviews technical and financial options with the farmer and drafts the Whole Farm Plan. The local Soil and Water Conservation District provides technical review of each plan before being approved by the full WAC. After approval the farmer signs a contract agreeing to implement the BMPs listed in the whole farm plan. The farmer implements the plan with assistance from the team and program staff provides continuing support to the farmer to ensure the plan's long-term success.³⁴

Best management practices approved through the WAP include:³⁵

- Barnyard Water Management System
- Filter Strip
- Diversion
- Fencing
- Planned Grazing Systems
- Strip-cropping
- Nutrient Management
- Subsurface Drainage
- Waste Field Storage
- Access Road Improvement

The WAC Ag Easement is another tool used to protect the watershed by encouraging sustainable management on existing agriculture and forestry lands. Similar to the land acquisition program fair market value is paid to farmers. A long term Conservation Stewardship Fund was begun to fund activities associated with the long term monitoring and assisting landowners with reserved right activities.

Bundled Services – Costa Rican Environmental Services Payment Program (PSA)

Costa Rica has one of the world's oldest and most extensive systems for paying for environmental services. Their Environmental Service Payment Program (ESPP) has its roots in The Forestry Act of 1996 which converted a previous subsidy based system to a broad based national system that paid for forestry environmental services.³⁶ The environmental services recognized include:

- Mitigation of greenhouse gas emissions
- Water protection for urban, rural, & hydro use
- Protection of biodiversity for:
 - Conservation

- Sustainability
- Scientific research
- Pharmaceutical uses
- Research and genetic improvement
- Protection of ecosystem and life forms
- Natural scenic beauty for science and tourism

The ESPP is the financing mechanism by which small and medium-sized producers are compensated for the management, conservation, and sustainable development of forest and biodiversity resources.³⁷ The program is administered by the National Forestry Financing Fund (FONAFIFO), a branch of the government agency Ministry of Environment and Energy.

The PSA program targets private landowners and to participate they must possess a sustainable forest management plan developed with the help of a licensed forester. These plans include the following:

- Proposed land use, land tenure issues, and physical access
- Information on:
 - Topography
 - Soils
 - Climate
 - Drainage
 - Actual land use
 - Carrying capacity related to land use
- Plans for:
 - Prevention of forest fires
 - Illegal hunting
 - Illegal harvesting
 - Monitoring schedules

After plan approval the landowner does the specified practice and receives an annual payment. The first payment can be paid at the time the contract is signed but subsequent annual payments are only paid once the practice has been verified to be in compliance.

FONAFIFO offers 4 different payments, forest conservation contracts, reforestation contracts, natural regeneration contracts, and agro-forestry payments.^{38, 39}

Forest conservation contracts: US \$64 per hectare per year (five year contract) for forest conservation easements. Most of the contracts in the PES program to date support forest conservation easements which target the conservation of vegetative cover in primary and secondary forest areas. Contracts can be renewed depending upon funds availability. These projects are targeted to include:

- Areas located in biological corridors (SINAC) especially those considered of high priority by the Ecomarkets Project (GEF)
- Areas within the influence area of the Huetar Norte Forestry project (KfW)
- Renovation of previously existing contracts, as long as they are located within the above mentioned priority areas
- Forest areas located in strategic areas for the protection of water resources of interest for rural aqueducts, national or municipal utilities

- Privately owned areas, within the protected areas, that have not been acquired or expropriated by the State
- Projects located in areas where the Social Development Index is under 40% (a relative index combining educational, health indicators with social indicators e.g. number of single mother births and electricity consumption, where 0% is the poorest area and 100% the best in Costa Rica (Ortiz et al 2003)).

Reforestation contracts: US\$816 per hectare, disbursed over a ten-year period. Landowners must make a commitment to maintain reforested areas for a period of ten years, depending upon tree species. These projects are targeted to include:

- Land use aptitude for forest plantations
- Location in relation to:
 - Conservation District in which the project is located; however, in the case of reforestation with native or endangered species, or natural regeneration, this does not apply, as the entire country is prioritized
 - Donor target areas (Huetar Norte Forestry Project-KfW)
 - Renovation of previously existing contracts
 - Projects located in areas where the Social Development Index is under 40%

Natural generation contract: US \$41 per hectare per year (five year contract)

- Areas that were deforested before 1986 and that can now be left for natural regeneration

Agro-forestry payments: US\$ 1.30 per tree. Although paid per tree there are special requirements in terms of species used and densities allowed.

- Projects submitted by organizations or individuals with certified capacity in managing 'forest'/timber trees in agroforestry regimes
- Land use aptitude for forestry
- Areas of high risk of soil or water degradation and biodiversity loss

Landowners can contract directly with FONAFIFO or with one of several non-profit groups that aggregate landowners into one contract. Individual landowners are monitored by the licensed forester that developed the sustainable forest management plan. Pooled projects are monitored by the non-profits that contracted with the landowner. In all cases audits are used to verify monitoring.

Current funding for the program comes from a variety of sources. Dedicated funding is provided through a percentage (3.5%) of the national gas tax, as well as a percentage (25%) of the national water tariff. These two sources are projected to provide approximately US\$ 8 million annually. In addition, contracts with individual water users ranging from hotels and municipalities to large water bottlers and hydroelectric power producers provide another source of revenue.

The gas tax revenue could be considered a payment for GHG reductions since the source of the funds originates from fossil fuel users. Likewise, the water tariff revenue could be considered payments for hydrological services provided.⁴⁰ To strengthen this argument it should be noted that large water users that have private agreements with FONAFIFO can deduct that amount from the total due as part of the national water tariff.

The PSA program has also received funding through the sale of carbon credits to Norway in the past and has more recently contracted with the World Bank's BioCarbon Fund for approximately 600,000 tons of carbon dioxide equivalents. Past funding for biodiversity was provided via a grant from the Global Environment Facility (GEF). GEF has re-affirmed their support with a commitment of US\$ 10 million for biodiversity

conservation. Conservation International is also providing funding of US\$ 0.5 million for specific activities in targeted areas.

More recently a marketing campaign has been developed whereby individuals and businesses can purchase certificate(s) for environmental services (CES) in an effort to raise additional capital from the private sector. Certificates are available for clean water, clean travel (offsetting airline emissions from visiting Costa Rica), and living forests (biodiversity).

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