



Poster Presentations for 2006 SWCS Annual Conference

BMP Evaluation/Design

US EPA agricultural best management effectiveness database

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As part of the effort to promote watershed planning, EPA is building an Agricultural Best Management Practice Effectiveness Database that will allow users to access a range of data on field tested structural and cultural practices and combinations of practices, costs, and effectiveness in pollutant control. Over time, this database will be populated with data from peer reviewed and agency studies and will be used to evaluate the result of potential watershed implementation options. The intended users are watershed planners, TMDL developers, watershed organizations, local government agencies, USDA technical field staff, as well as the general public and the university and research community. Currently the database is under review and will be made available on the EPA website in 2006.

The database will

- Increase accessibility to a consistent, complete, and dynamic repository of Agricultural BMP information and to provide additional support in organizing and understanding available information.

- Educate the agricultural community and the public on the success and failures of various Agricultural BMPs.

- Create a forum for information exchange across the Agricultural community.

- Help plan and develop comprehensive Agricultural research and studies, to improve on the quality of available data from past studies, and to eliminate past problems, in turn, saving time and money on new studies conducted.

Irrigation stress and mulching effects on selected proven introduced ornamental plants

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Almost 78% of the new ornamental plant species that were introduced earlier in Kuwait proved adaptable to Kuwait's environmental conditions. To further enhance our understanding of the introduced plant's cultural needs and to promote efficient use of limited natural resources, such as water, in their production, it is important to conduct studies on ascertaining fertilizer and irrigation water requirements, insect pest and disease incidences and their control. Hence, this seven month project was initiated in June 2002 to determine the effects of water stress and mulching on the growth and greenery impact of four proven adaptable new plants (*Vitex agnus castus* VA, *Caesalpinia mexicana* CM, *Myoporum parifolium* MP and *Rosmarinus officinalis* RO). The main objective of this project was to find effective ways or means of conserving irrigation water.

Sufficient quantities of planting materials were raised from the mother plants in the Ahmadi Biopark. These were planted at KISR's Urban Demonstration Gardens site in Salmiya. Plants were subjected to water stress by irrigating them at the rate of 25, 50 or 100 % of the daily evapotranspiration rates (3.75, 7.5 or 15.0 mm/d). Organic mulches (processed bark or compost) procured locally were applied to the soil surface after planting.

Data recorded at weekly intervals during the initial 87 days of planting indicated significant main effects (irrigation and species), but their interactions were not evident for both water stress and mulching experiments. Plants watered at the rate of 7.5 or 15.0 mm grew faster than those that received lower

amounts of water (3.75 mm/ d). Plant canopy appeared to be more sensitive to water stress than the height. The application of processed bark as a surface mulch was found better than the compost in increasing plant height and canopy in CM, MP and RO. However, VA plants in compost mulch had larger canopies than those in bark. The root zone soil moisture regimes were similar in all treatments.

Conservation Technology and Tools

Remote sensing crop residue cover

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Current methods of quantifying crop residue cover are inadequate for characterizing the spatial variability of residue cover within fields or across large regions. Our objectives were to evaluate several spectral indices for measuring crop residue cover using satellite hyperspectral data and to categorize soil tillage intensity in agricultural fields. Hyperion imaging spectrometer data were acquired over agricultural fields in central Iowa in May 2004 and 2005. Crop residue cover was measured in corn and soybean fields using line-point transects. Crop residue cover was linearly related to the cellulose absorption index (CAI) with coefficients of determination (r^2) of 0.85 in 2004 and 0.69 in 2005. Three tillage intensity classes, corresponding to intensive (<15% residue cover), reduced (15-30% cover), and conservation (>30% cover) tillage, were correctly identified in 63-68% of fields. Classification accuracy increased to 68-82% for two classes, corresponding to conventional (intensive + reduced) and conservation tillage. Inventories of soil tillage intensity by previous crop type were generated for the whole Hyperion scene in each year. Regional surveys of soil management practices that affect soil conservation

and soil C dynamics are possible using advanced multispectral or hyperspectral imaging systems.

Predicting nitrogen fertilizer recommendations for corn using an active sensor

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Active sensors, mounted on agricultural equipment, can be used to estimate N (nitrogen) status in corn. This has the potential to improve N fertilizer recommendations that will reduce NO₃ loss to the environment. This study examines the relationship between remotely sensed data and corn yield and considers ways to translate this information into sound sidedress N recommendations for corn. Four research sites with unique cropping histories in Centre County, PA were planted to corn in 2005 with three different pre-plant treatments (zero, 56 kg N ha⁻¹ as NH₄NO₃, and approximately 56 kg N ha⁻¹ as manure) and seven sidedress rates (0, 22, 45, 90, 135, 180, and 280 kg N ha⁻¹ as NH₄NO₃) in 9.1 x 4.5 m plots. Nitrogen fertilizer and manure was surface applied. From early May until mid-July, georeferenced canopy reflectance data in the 590nm and 880nm wavelengths were taken each week from the third row of each six-row plot. Inorganic soil N, chlorophyll meter readings, late-season stalk nitrate, and grain yield were measured. Preliminary results from two field sites suggest a significant relationship between light reflectance and the Economic Optimum N Rate (EONR; $r^2=0.984$). The EONR in a field following corn for the zero and manure pre-plant treatments were 150 and 132 kg N ha⁻¹, respectively; whereas in a field after soybeans, the respective EONR's were 34 and 48 kg N ha⁻¹. Initial results indicate that employing a ground-based active sensor is a viable option for predicting site-specific N sidedress rate recommendations.

Conservation tillage for vegetable production

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Conservation tillage has become common for many row crops over the past 30

years. Adapting conservation tillage for vegetables has made slower progress, mainly because of the higher value of the crop, increasing the risk by the farmer to adapt this culture. We have applied conservation tillage to many vegetables grown in North Carolina, with varying degrees of success. This poster will show results of growing vegetables with conservation tillage (both no-till and strip-till), and indicate which vegetables can be successfully grown with less tillage. Vegetables include tomatoes, pumpkins, peppers, cole crops, squash, sweet corn, cucumbers, and potatoes..

Making cropping systems diverse, dynamic, and sustainable

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High residue-producing crops are seen as the answer to many resource management problems. When working with producers to develop crop rotations and cropping systems, the primary emphasis of conservation agencies and groups is crop residue - growing it and managing it. Crop residue can control erosion, reduce runoff, and help increase soil organic matter levels. But there is more to good resource management than that. An effective cropping system addresses not only erosion, runoff and soil organic matter - it also addresses pesticide resistance by weeds and insects, soil biotic diversity and the sustainability of the cropping system itself. The authors will summarize the current knowledge of cropping system diversity and dynamic cropping systems, and present a scheme to extend these concepts beyond the general area where they have been developed. The benefits of these systems, for both the producer and for the agricultural community in general, will be presented.

Long-term erosion trends on cropland in the Pacific Northwest

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Winter erosion from non-irrigated cropland in northwestern Oregon, southeastern Washington, and northern Idaho appears to have decreased during the past 20 years. Assuming this effect is real and not just apparent, is there a single cause? Is this the effect

of climate change, changes in the result of the 1985 farm bill, or a combination of these and other factors? We can't answer all these questions, but a unique 43-year data set obtained from monitoring winter erosion on a large number of sample fields in Whitman County, Washington for water year 1940 through 1982, provides an opportunity to examine historic trends in erosion and corresponding climate conditions. We examined diurnal freeze/thaw cycles, length and severity of frozen periods, snow-melt accumulation during cold periods, and rain during early stages of the thawing process. Our analysis of the 1983 through 2005 climate data indicate reduced erosion hazard from freeze/thaw effects. U. S. Department of Agriculture progress records indicate an increased application of conservation practices between 1979 and 1994, with a reduction in erosion. Measurement of sediment at the mouth of the Palouse River indicated a large reduction between 1962 and 1996. Sediment in runoff and flooding from snow melt on frost impacted soil occurred in water years 1996 and 1997, but erosion rates were not catastrophic.

Ensuring adequate replication in on-farm tests

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Farmers like on-farm research because they can see test treatments applied across variable landscapes and they can use farm-sized equipment for management operations. However, many are unaware of the principles of experimental design and replication.

Three such research projects are the Wilke Project in Lincoln County, Washington, the Northwest Crops Project in Whitman County, and the Spokane County Direct Seeding Project.

In the first two projects, participants compared 3-year and 4-year direct seed crop rotations. In the Wilke Project, 5 farmers each repeated one rotation for 4 years in 10-25-acre plots or as whole fields. In the Northwest Crops Project, 7 growers each maintained one replication of both rotations for 7 years in 30 ft by 600 ft plots.

Where crop rotations were in strips or small fields their management was often not optimal as the farmer's large fields were a higher priority. Conversely, when the farmer included whole fields in the test he sometimes changed the rotation due to weather or economics.

In the Spokane Project, 5 farmers each answered one question in their transition to direct seeding. They replicated trials in the

field for 3 years. These reductionism tests showed treatment differences, but did not provide a complete picture of direct seed systems. This farmer group received education on experimental design and demonstrated good understanding of the value of plot replication. Modest payments also provided them with an incentive to complete the trials as specified.

Revegetation equipment catalog

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The revegetation equipment catalog provides a source of information on current equipment that can be helpful in planning and implementing revegetation projects. The Rangeland Technology and Equipment Council (RTEC) in cooperation with the USDA-FS Rocky Mountain Research Station and BLM Great Basin Restoration Initiative has compiled a web-based publication that provides a description, applications, photographs, and vendor contact information for equipment that is designed for rangeland vegetation manipulation, wildlife habitat improvement, soil and water conservation, and disturbed land rehabilitation. The web-based publication will allow updates and widespread access. Chapters include information on tractors, all-terrain vehicles, global positioning systems, transport trailers, and equipment for site preparation, fertilizing and mulching, seeding, seed harvesting and processing. Also included is equipment for controlling plants mechanically, chemically, and by fire, and miscellaneous items. The catalog is available on the World Wide Web at <http://reveg-catalog.tamu.edu>. Catalog contact: Harold Wiedemann, Professor Emeritus, 4000 Stony Creek Lane, College Station, TX 77845; phone: 979-690-8685; h.wiedemann@verizon.net.

Enhancing environmental quality and resource conservation in Pacific Northwest Kentucky bluegrass seed agriculture

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Conventional farming practices are not always cost effective and environmentally sound. In Spokane County, Washington, the effects of direct seeding and conventional planting and residue management of Ken-

tucky bluegrass grown for seed were studied with respect to soil and water quality. During the first and second year of seed production, direct seeding (no tillage) establishment reduced shallow ground water nitrate-N concentrations by 44% and ammonium-N by 78%, compared to conventional tilled treatments. Direct seeding also reduced surface soil erosion. On the wet north-slope fields, first-year seed yield was lower ($P = < 0.05$) with no-till establishment compared to conventional seeding methods. Second-year seed yield was not affected by full straw load or tillage treatment ($P = 0.05$). First-year seed yield was negatively correlated ($r = 0.92$) with total above ground plant nitrogen. Harvest index for the second-year seed crop was highest with direct-seeded treatment. Direct seeding can be challenging to adopt but it shows promise in Kentucky bluegrass seed production systems in reducing nutrient and sediment runoff and enhancing economic returns over conventional methods.

Fish/Wildlife Habitat

The fish communities of Oxbow Lakes in the lower Kaskaskia River basin from 1960 to 2003 and their effect on nutrient cycling

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Fish populations in four oxbow lakes along the lower Kaskaskia River, Illinois were sampled with seines and electrofishing from 1962-1966 and again from 1997-2001. The fish communities were very similar between time periods; however, we did find higher relative abundance of common carp and bluegill and lower abundance of golden shiner during the more recent sampling period. We explored the influence of bluegill on nutrient cycling within the oxbow lakes by testing the nitrogen (N) and phosphorus (P) excreted by bluegill after eating different types of prey. Each of 20 fish (50-60mm, TL) was tested four times, once after each of four feeding treatments (fed odonates, chironomids, Daphnia, or starved). Diet had a significant effect on excretion for both N ($F_{2,12} = 6.27$, $p = 0.01$) and P ($F_{2,12} = 4.13$, $p = 0.04$). Excretion of N was higher after fish had eaten odonates (Tukey $p < 0.01$) or Daphnia (Tukey $p < 0.01$) than when they had eaten chironomids. Excretion of P was higher after fish had eaten

Daphnia than after eating chironomids (Tukey $p = 0.04$). Excretion by fish that had eaten odonates was not significantly different from the other two diet treatments. With the relative stability of fish communities in the oxbow lakes over several decades, the role of fish in nutrient cycling appears to be a function of prey selection by fish.

Land Use Planning

Small acreage impacts to our natural resources

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It's very important today to educate landowners, particularly small acreage owners the importance of our natural resources. This poster covers the physical, biological, economic and social factors associated with small acreage grazing. Soil compaction, pore space and the characteristics of healthy soil versus compacted soil is described. Water quantity/quality is covered with off-site water development and improving soil banks or buffers to protect water quality. Plant and root health is described in its relationship to grazing impacts. Animals are covered by addressing supplements, grazing needs for livestock and pocket gopher invasions. The human and social aspect of small acreage grazing covers de-valuing of property compared to pastures in good condition. This introduction covers the influence and affects this land use and management has on soil, water, air habitat, plant habitat, and animal impacts. The next section covers the application aspect of grazing small acreage and its management. This section explains AUM's, condition classes, calculating available forage, determining the grazing percent, calculating a grazing schedule and demonstrating an acres to animal unit graph chart. The poster wraps up with how to correct an overgrazed pasture in an eight step process. This poster can be the basis for developing effective conservation education to address environmental management systems as an individual landowner in this newly growing semi-rural environment. It can also aid in the strategy to address small acreage management for local or county planning. Eighteen charts/photos/figures make this poster easy to follow and understand. A CD will be available..

An evaluation of physical land suitability for the special citrus fruit using GIS and multi-criteria approach

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The objectives of this study were to establish spatial model in land evaluation for citrus fruit using GIS at the smallest commune unit and to make the basic for the decision maker to replace none suitable crops by the suitable crops.

The methodology used for the physical land suitability assessment for special citrus fruits is a multi-criteria evaluation approach within GIS context, based on FAO land evaluation framework, modified for Vietnamese conditions.

A representative study area, the hilly commune Huong Binh, covers a natural area 6637 hectare and is located in Thua Thien Hue province, Vietnam, with 16 soil units (FAO/UNESCO/WRB). Slope varies from 30 -150, soil depth is 30 cm to more than 100 cm, scarce water resource, soil fertility is poor to moderate. The study was carried out by overlapping all theme maps with scale 1: 10000 with GIS techniques for gathering the land evaluation mapping of units and physical land suitability classification. Results showed that there are 36 land evaluation mapping units in the study commune. A total of 2348.42 ha were suitable for citrus fruit production, of which 10% was moderately suitable (S2), and 90 % was marginally suitable (S3). Poor soil fertility, lack of irrigation, erratic rainfall, soil degradation are the most serious physical problems influencing yield and quality of citrus fruit and need a improvement first.

Vineyard site selection in Massachusetts

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Over the past few decades Massachusetts has heavily invested in sustaining farmland through the establishment of conservation easements. Unfortunately, contemporary economics have challenged the traditional agriculture paradigm, with more farmers finding it increasingly difficult to return a profit from their land. Vineyards have recently shown to be a viable alternative enterprise to sustain small scale agriculture through a high value product and agrotourism. The quality of a particular wine, however, is deeply embedded in the geo-

graphic origin of the grapes used to produce the wine. Consequently, Geographic Information Systems (GIS) are useful to map the geographic factors associated with vineyards. The purpose of this project is to use GIS to define the existing landscapes in Massachusetts amenable to viticulture in order to target production in areas that are potentially the most productive.

The process involved overlaying data on macroclimate and mesoclimate, such as frost dates, frequency of extreme low temperatures, degree days, aspect, slope, present land use, and soils. Site specific criteria relevant to each variable were established defining favorable landscape characteristics for vineyards. These parameters were incorporated into a GIS model to analyze these data layers in order to produce a map displaying parcels available for sustainable wine grape production in Massachusetts. The model not only targeted specific farms in the state that may consider viticulture, but was also used to establish a relative value, based on the landscape's ability to sustain vineyards, across the state of Massachusetts regardless of current land use.

Monitoring/Estimating/Reporting Results

Targeting nitrogen management evaluations on Iowa corn fields

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Nitrogen (N) fertilizer management is a major resource management concern for both economic and environmental reasons. The increased cost and policy implications have led many growers to participate in voluntary programs that assist them in evaluating the N status of their corn fields. More than 1,000 fields were evaluated in the 2005 crop season in Iowa, supported by private, state and federal funding sources.

Because of the within-field variability of N status, techniques to account for spatial variability were implemented. The basic level of N management evaluation was a guided end-of-season stalk nitrate sampling using targeted points based upon georeferenced color aerial imagery and digitized soil map unit data. This targeted sampling permitted growers to evaluate how much N was available to the crop, including excess N, for different areas/environments in their field.

A more advanced approach was for growers to apply alternating strips of two N management practices and measure the yield

differences with combines equipped with yield monitors and GPS. Where actively managed, specific management practices, such as fall vs. spring application of N fertilizer, can be evaluated at a scale and frequency to adequately represent a targeted area, such as a given soil type or a whole watershed.

While both evaluation methods were helpful, the greatest impact occurred when using a combination of survey data from the guided stalk sampling and the replicated strip testing. Results from this program show that evaluations, when executed and interpreted correctly, can be a tremendous tool motivating growers to change voluntarily.

Spatial patterns of soil erosion and deposition in two small, semi-arid watersheds

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In semiarid ecosystems, soil erosion is influenced by the dominant vegetation, soils, and landscape morphology. Rates and spatial patterns of soil redistribution were measured using the ¹³⁷Cs technique in a 3.7 ha, shrub dominated watershed and a 1.9 ha, grass dominated watershed in the Walnut Gulch Experimental Watershed in southeastern Arizona, USA. The calculated soil redistribution rates ranged from -9.8 to +5.7 t ha⁻¹ year⁻¹ and -7.9 to +10.1 t ha⁻¹ year⁻¹ for the shrub and grass watersheds, respectively. The mean soil loss rates in areas of net loss were -5.9 and -3.2 t ha⁻¹ year⁻¹, and the calculated net erosion rates for the entire watershed, including depositional areas, were -4.27 and nearly zero t ha⁻¹ year⁻¹ for the shrub and grass watersheds, respectively. The results indicated that both soil loss and sediment yield from the shrub watershed over the past 40 years were greater than that from the grass watershed. However, erosion rates in the grass watershed were relatively great considering the fact that sediment yields from that watershed were very small, which indicates that sediment yield from a watershed outlet can be a poor indicator of hillslope erosion rates within the watershed. The soil loss difference between watersheds was probably attributable to the differences in vegetation, while the sediment yield difference was largely controlled by the existence or lack of incised channels. The calculated net soil redistribution rates were dependent on the percent of rock fragments in the top 25 cm regardless of the different vegetation ecosystems.

Validation of the hydro-estimator algorithm over a tropical region

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This is the first time that the Hydro-Estimator (HE) algorithm is validated over a tropical region. A heavy convective storm that occurred over the eastern part of Puerto Rico (PR) was selected to conduct a preliminary validation of the HE. The selected tropical storm occurred during November 11-13, 2003 and generated a significant flash flood over the urban and agricultural areas. Puerto Rico is a small island located in the Caribbean basin and has a densely rain-gauge network that provides the unique data set to conduct an accurate validation. The United States Geological Survey monitors about 125 rain-gauges located through PR and records rainfall every 15 minutes.

Estimation of precipitation was generated by the same spatial and temporal distribution using the HE algorithm and the closest grid to a particular rain gauge was used to perform rainfall comparisons. Continuous and discrete events were compared and the following scores were computed: the probability of detection, the false alarm rate, the bias of estimation, and correlation between observed and estimated rainfall. Preliminary results show that the HE algorithm provides reasonable estimation of precipitation. However, underestimates heavy precipitation. The correlation coefficient is 0.6 between observed and estimated rainfall events and was developed considering 72 hours of cumulative rainfall and 125 rain gauges.

Spatial and temporal contributions to variability in sediment loads of the Umatilla River, Oregon

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Forty stream segments in the Umatilla River subbasin in Oregon were designated water quality limited and placed on the US Clean Water Act's 303(d) list, in 1998. A unique cooperative effort of local, county, state, tribal, and federal agencies and private citizens developed the Umatilla River Basin Total Maximum Daily Load and Water Quality Management Plan (TMDL/WQMP), which was approved by the USEPA in 2001. Sediment data is being used to establish a

baseline for determining progress in meeting sediment targets in the TMDL/WQMP.

Our goals are to: 1) determine the relationship between land use and development on sediment delivery to streams, 2) determine variation and quantity of sediment during seasonal events, and 3) identify sediment load contributions from tributaries to the mainstem Umatilla River. There are currently 11 sampling stations in the Umatilla River and major tributaries. Daily composite samples are collected with automated pumping samplers, at 6-hour intervals, and analyzed for total suspended solids, total dissolved solids, conductivity, and turbidity.

Analysis and summary of seven years of data show highly variable daily, seasonal and annual sediment loads in the mainstem Umatilla and tributaries. Detecting and linking change in sediment loads specific to management changes at the scale of the Umatilla Subbasin is problematic because of variability and lag time in responses. We are focusing monitoring efforts on a high priority tributary to improve the potential for linking upland and riparian management to instream sediment transport.

Social/Economic Assessment

Economics of herbicide-resistant technology fees in conservation tillage systems for cotton

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The availability of herbicide-resistant technologies such as Roundup Ready cotton has facilitated weed control in conservation tillage systems such as ultra-narrow-row cotton (UNRC). UNRC is generally planting using a row-spacing of 38 cm or less and no-tillage production practices. Another defining characteristic of UNRC production is the use of a high plant population and a finger stripper to once-over harvest the crop. The way that Roundup Ready technology fees have been priced to farmers growing cotton has changed several times since 1996 when the technology was introduced. This study evaluated the effects on UNRC profitability of four different Roundup Ready cotton technology fee regimes used since 1996 by Monsanto, the technology license holder. UNRC net revenues were calculated for each technology fee policy using yield and fiber quality data from a 1997 through 2000 UNRC PPD study at Milan, TN. Results indicate that

when the technology fee is tied to the amount of seed planted, there is an incentive to use a much lower target plant population in both wide-row cotton and UNRC to reduce seed and technology costs by more than the loss of yield. Because of the high seeding costs with UNRC, the current technology fee policy provides an incentive for farmers to switch from UNRC to wide-row cotton and to lower the seeding rate. For farmers who do plant UNRC, they may be able to reduce costs and improve net revenues by using a plant population that is much lower than the current common practice.

Finding out what happened: 50 years of applied conservation practices on a Mississippi watershed

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Land management within a watershed has impacts far beyond its boundaries. Increasing private and public interest in whether conservation investment has been effective led to the Conservation Effects Assessment Project (CEAP). As part of the national program, CEAP efforts in north Mississippi will document implementation of practices through various government programs over the past five decades within one watershed.

The Yalobusha River is one of the major contributors to Grenada Lake in North Central Mississippi. The Upper Yalobusha River Watershed (YRW), comprising 168,750 ha, is defined from a point in Grenada Lake near the confluence of the Yalobusha in the lake. Land use within the YRW is 18% cropland, 19% pasture or grassed areas, 53% forested areas, 6% wetland that is largely forest, and 4% surface water or urban areas.

Resource issues within the YRW include sedimentation, sheet and rill erosion, stream bank instability, and nutrient enrichment. These have been addressed through local implementation of national programs such as the Soil Bank Program of the Agricultural Adjustment Act of 1956, the Conservation Reserve Program of the Food and Agricultural Act of 1977, the National Agriculture Research, Extension, and Teaching Policy Act, the Food Security Act of 1985, the Food Agricultural Conservation and Trade

Act of 1990, and the Farm Security and Rural Investment Act of 2002. Targeted north Mississippi projects for watershed conservation in the YRW include Watershed Flood Prevention by the Natural Resource Conservation Service, Demonstration Erosion Control by the Agricultural Research Service, and Forestry Restoration by the USDA Forestry Service.

Within this component of the overall CEAP effort, we are documenting the monetary investment, location, and condition of installed conservation practices within the Little Topashaw Creek watershed within the YRW. The next phases will assess the physical effectiveness of the installed practices, and explore the socio-economic factors that inform individual conservation decisions.

Soil Quality

Impact of soil calcium carbonate content and phosphorus source on phosphorus runoff

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The objectives of these experiments were to determine (1) the impact of soil CaCO₃ levels on the relationship between soil test P (Mehlich 3) and runoff P levels and (2) P source influences on runoff P concentrations. Experiment 1 took place on three soils with 1%, 4%, and 9% calcite by weight. Eight beef manure treatments were replicated at each location. Experiment 2 took place in Colorado on a fine-loamy soil. Four treatments were applied at two rates: dairy manure, windrow compost, vermicompost, and rock phosphate. All manure-based treatments were made from the same dairy manure. The same field and laboratory methods were used for both experiments.

In Experiment 1 the Kim soil with the highest calcium carbonate concentration sorbed the most phosphorus; however, this resulted in the lowest percentage of P saturation in the soil due to the high Ca concentration. A multiple regression equation was developed across locations to predict total dissolved P in runoff from soil test P and percent CaCO₃ by weight. The R²-value is 0.92 using the Mehlich-3 extractant and 0.81 using Olsen's. Experiment 2 concluded that the addition of raw manure resulted in greater concentrations of P in runoff than the composted and vermicomposted manures.

In conclusion, to minimize P runoff from land applied manure, farmers will be encouraged to compost manure prior to application or to select fields with higher CaCO₃ levels to receive manure.

Carbon distribution and leaching on an eroded landscape in Southwest Wisconsin

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Leaching and spatial distribution of carbon © within a soil profile and across a landscape is influenced by many factors such as vegetation, soil erosion, water infiltration, and drainage. We measured C distribution and leaching for three levels of erosion (slight, moderate, and severe) and developed a three-dimensional (3-D) map of the site using a profile cone penetrometer (PCP). This map displays the distribution of the total depth of the Ap and Bt1 horizons and the upper part of the 2Bt2 horizon. A map of soil carbon distribution was created for this landscape using C content information obtained from soil samples. Using C distribution for the upper two horizons we developed a 3-D map of soil C distribution for this eroded landscape. The 3-D assessment of C distribution provides a better means of assessing the impact of soil erosion on C fate. It was estimated that there were 52 Mg/ha of total C in the surface (Ap) horizon and 61 Mg/ha in the Bt1 horizon. This increase in C with depth in the soil can be attributed to an increase in clay content and C leaching resulting in stable carbon-clay complexes.

Targeting Conservation Efforts

Nitrogen dynamics and soil erosion in crop and livestock systems with potential bioenergy stocks in western Iowa watersheds

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Agricultural land uses affect leachable nitrogen (N), erosion and soil organic nitrogen (SON) dynamics. We constructed a N-budget model and used the Water Erosion Prediction Program to estimate changes in those parameters due to changes in land use in western Iowa. Currently, SON is being depleted and leached nitrate produces sub-

stantial loads in streams. Annual erosion rates are currently as much as 22 Mg ha⁻¹; double the regional maximum theoretical soil regeneration rate (T). If 50% of above-ground maize residue was removed for biomass energy production, SON deficits would double and they would more than triple if 100% of the residue were removed. Compared with the current system, an alternative system that increases perennial vegetation and integrates crops and livestock reduces erosion to less than regional T, reduces leachable N by half, and increases SON. Under this alternative land-use, 50% of maize residue can be removed for energy stocks without substantially negating improvements in leachable N and SON provided by increased vegetative cover and crop-livestock integration. However, SON will be depleted when 100% of maize residue is removed under the alternative land-use. Removal of 50% of the maize residue produced 1.8-million tons biomass under current conditions and 1.4-million tons under the alternative land-use. Current land-use could generate 1.3-billion L ethanol from exported maize grain and 170-million L biodiesel from exported soybean grain. Under the alternative land-use, exported maize could provide 1.0-billion L ethanol and exported soybean could generate 159-million L of biodiesel.

Water Conservation

Illinois family faces behavioral challenge in attempts to save water

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During the Midwest's drought in 2005, the mayor of a city near Chicago reflected worries when he wrote, "I have said many times that we need to start thinking of water as more a resource than a commodity. And, we need to do much more to use the water that we have wisely."

Indeed, conservation experts generally agree that the Earth's reserves of clean drinking water are not infinite, and that humans need to save as much as possible through efficient usage. How individuals can save water is explained on the internet by various agencies, but it is unknown to what extent people know about those suggestions, take them seriously, and attempt to comply.

Sheaffer & Roland, civil engineers of Geneva, Illinois, supplier of water to a 2,000-home upscale subdivision, presents the results of its four-month study of one

family's efforts to reduce its in-home use of water by at least 10 percent.

Tables, graphs and other illustrations are used to depict the problem, the research goals, the method, and the results of the study. Included are data on the how-to- conserve information supplied to the family, the incentives, and their attitudes and behaviors. The study covers the first four months of 2006.

Use of polyacrylamide to reduce seepage from unlined irrigation canals: Small scale tests.

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Polyacrylamide (PAM) is a class of long-chain synthetic polymers that has been shown to reduce furrow erosion. Recent evidence suggests that the application of linear, anionic PAM to unlined irrigation canals reduces water lost as seepage. A diverse set of experiments at multiple scales has been initiated to understand the efficacy of PAM usage within irrigation ditch environments. The objective for this study was to assess the effectiveness of application methods and concentrations on seepage reductions in small-scale troughs. Minimization of PAM application is desired to reduce the potential downstream movement of PAM, reduce any potential effect on aquatic species, and reduce the environmental exposure of acrylamide, a carcinogenic impurity present in low concentrations in PAM.

The Test Troughs consist of two 24 m long, 10 cm deep furrows formed from native sand. Water inflows (70 L/min), outflows, and seepage were continuously measured. The application of 11 kg/ha of granular PAM resulted in the greatest seepage reductions (81±10 %) and did not increase with higher application rates. When applied as a partially hydrated PAM solution, seepage reduction was 61±13% regardless of application rate. As little as 1 kg/ha of PAM (applied as a solution to achieve a water column concentration not to exceed 1 mg/L of PAM) was found to have reduced seepage by 68±7%. Granular PAM treatments had the greatest concentration of PAM in surface water outflows, routinely up to 1 mg/L within the first 30 minutes. Granular PAM can be transported downstream prior to its dissolution within irrigation canals.

TerrAqua and the Ohio Vernal Pool Partnership

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The SWCS student chapter, TerrAqua, at the Ohio State University, has become chiefly involved with the Ohio Vernal Pool Partnership program, ran jointly between the Ohio Environmental Council and the Ohio Nature Conservancy. The Ohio Vernal Pool Partnership is a response to the urgency to find and protect what is left of Ohio's rapidly dwindling wetlands. This is particularly true in the case of isolated wetlands, such as vernal pools, which due to a recent court case, are no longer protected under federal law. The purpose of the Ohio Vernal Pool Partnership Program is to involve communities, organizations, and individuals in the monitoring of Ohio's vernal pools. A standardized monitoring form guides the participant in recording various indicators of the vernal pool's condition, including but not limited to; physical dimensions, vegetative buffer zones, plant communities, invertebrate species and amphibian species. Through these methods, conservationists hope to gain an inventory of where Ohio's remaining isolated wetlands are, and assess their quality. TerrAqua's major role in this program is public outreach through a series of seminars given by professional speakers, workshops on how to monitor, and visits to local high schools.

Water Quality

Runoff, sediment, and nutrient losses from grazed wheat summer management practices

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Grazed winter wheat of the southern Great Plains relies on the incorporation summer management practices, including fallow and summer legumes. This study examined late summer runoff and runoff water quality using a rainfall simulator from pastures using two winter wheat management strategies: winter wheat with summer chemical fallow (CF) and winter wheat with summer

legumes (SL) and two grazing treatments (grazed and ungrazed). Using conservation tillage, four (1.6 ha) pastures were planted in winter wheat and grazed from November to May. Summer legumes were direct seeded in two of the pastures while the other pastures were in fallow. A rainfall simulator was run on grazed and ungrazed paired plots, two per pasture and 1.5m x 3m in size, and runoff from each plot was measured. Runoff samples were collected and analyzed for nutrients and sediments. Rainfall intensity of 10cm/hr, which represents a late, high intensity summer storm, was used. Results show the CF practice had greater runoff, sediment, and nutrient losses than the SL strategy. Likewise, grazing produced greater runoff, sediment, and nutrient losses than ungrazed plots. The CF pastures, which incorporated winter grazing, lost 71% of applied rainfall. The greatest losses for sediment (284 kg/ha), NO₃-N (124 kg/ha), BAP (380 g/ha), and WSP (38 g/ha) were also found with the grazed CF practice. Understanding the mechanism of interaction between late summer storms and summer management practices will improve large scale mitigation strategies to reduce erosion and enhance capture of water resources.

Environmental impacts from pasture-based dairies in Argentina and Uruguay

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Pasture-based livestock production is considered an environmentally-friendly alternative to confinement systems. The dairy industries in Argentina and Uruguay are pasture-based for many reasons including high input costs, low milk prices, and lack of subsidies. The most intensive dairies feed concentrates and use high stocking rates and intensively managed grazing. Cows are milked twice a day, and the floors of the milking parlor are usually washed with a hose. A survey of Argentine dairies showed that 20% of dairies release their effluent to streams without any treatment (Herrero and Gil). Of the remaining 80% of dairies claiming to treat effluent, about 58% have a lagoon, 6% use a natural lagoon, 14% use a natural drainage or creek, 17% drain to a pasture, and 5% drain to a natural depression, ditch, or channel. In other words, over 50% of dairies do not treat wastewater be-

fore it is released to a pond, creek, or pasture. Iramain and Herrero et al. (2002) sampled 61 wells located on dairies in Argentina. They found the most common contaminant to be microbiological (specifically, coliforms, *E. coli*, and *P. aeruginosa*) with 72% of wells having contamination above recommended levels. Arsenic contamination above drinking water standards was documented in 63% of wells, and nitrate contamination was documented in 28% of wells. Well contamination was related to proximity to the milking parlor, well construction, and groundwater depth. On-site evaluations were done on 20 dairies, leading to the development of manure management principles for water quality protection on pasture-based dairies.

Long-term simulation of soil-crop-nitrogen interactions in the semi-arid Canadian prairies

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Modelling techniques are used to evaluate the impacts of soil and crop management practices on the risk of environmental contamination. We investigated the capability of the process based HERMES model, developed for sub-humid agricultural conditions in Central Europe, to simulate soil water, crop growth and nitrogen (N) dynamics over a 25 year period under the semi-arid conditions at Swift Current, Saskatchewan, Canada. Results of two crop rotations (continuous wheat and fallow-wheat) were compared in terms of crop biomass and grain production, water and N dynamics and N losses via leaching. All crops were managed using conventional tillage practices and were fertilized at soil test recommended rates of N and P. Model performance was analyzed by comparing the simulated soil and crop state variables to observed measurements. The model calculated crop biomass, grain yield and N uptake well, with coefficients of determination (R^2) of 0.88, 0.70 and 0.72, respectively. Soil water content during the growing season was calculated with an R^2 of 0.79; however, simulating soil water dynamics during the winter period was less successful. Although simulated soil mineral N in the 0 - 120 cm depth was mostly within the standard deviation of the replicate observations, the high variability of the measurements resulted in poor correlations between simulation and observations.

Simulated 25 year cumulative leaching of N was small (~ 10 kg N ha⁻¹) under continuous wheat, but increased to 300 kg N ha⁻¹ under the fallow-wheat rotation; most of this leaching occurred in fallow years when precipitation amounts were above normal.

Does a variable nitrogen management site-specific management zone reduce nitrate leaching?

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Although nitrogen (N) is an essential nutrient that is a key component of intensive irrigated agricultural systems, its management to maximize yields and reduce losses to the environment is difficult. One reason is due to the spatial and temporal variability that affect residual soil nitrate-N ($\text{NO}_3\text{-N}$) and $\text{NO}_3\text{-N}$ leaching potential. The objective of this study was to evaluate the potential of N fertilization based on site-specific management zones to reduce $\text{NO}_3\text{-N}$ leaching losses. We mapped site-specific management zones based on soil color from aerial photographs, topography, and the producer's past management experiences that reflect spatial soil variability. We used the Nitrate Leaching and Economic Analysis Package (NLEAP) model to assess the benefits of N management based on site-specific management zones. Nitrate leaching was variable across management zones with the highest leaching occurring in the low productivity zone. This study found that productivity zone is an important spatial factor in determining $\text{NO}_3\text{-N}$ leaching potential since site-specific management zones characterized the variability of factors that affect $\text{NO}_3\text{-N}$ leaching. As the N fertilizer rate is increased by productivity zone the rate of $\text{NO}_3\text{-N}$ leaching increased faster for the low productivity zone creating a "higher leaky zone." Furthermore, this study demonstrates that spatially variable N management based on productivity zones produces less $\text{NO}_3\text{-N}$ leaching than uniform strategies while maintaining maximum yield. We estimated that by using a Site Specific Management Zone we reduced $\text{NO}_3\text{-N}$ leaching losses by 25 percent during the first year after a site-specific management zones nutrient management plan.

Soil and water quality implications of oak woodland restoration

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The ecological restoration of Iowa's oak woodlands has a direct impact on both water and soil quality. We contend, an oak woodland, once restored to its pre-settlement condition, has the capacity to infiltrate virtually all of the rainwater that falls on its surface. One characteristic of a restored woodland is the ubiquitous distribution of graminoids. The fibrous root system of these graminoids, and the resulting build up of soil organic carbon are believed to be the major factors in providing high infiltration rates. Unfortunately, most Iowa woodlands lack sufficient management. This results in woodlands much denser than existed prior to settlement. The result is a very shaded understory yielding a very sparse distribution graminoids. Infiltration rates drop, and there is a lack of a fibrous root system to hold the soil. Consequently, more precipitation runs off and carries more sediment with it.

The Iowa Valley RC&D has been involved with several woodland restorations and have documented the floristic changes as a result of the restoration. During the 2006 growing season, rainfall simulations will be conducted at four pairs of test sites, each pair consisting of a restored and un-restored component. Each site will be characterized by: graminoid cover, floristic quality, soil organic carbon, soil bulk density, and soil aggregate stability. The results will allow for the correlation of woodland restoration with various soil and water quality parameters. The mismanagement of "natural" land has a significant impact on Iowa's natural resources.

Compost and runoff analysis results from a windrow composting/vegetative filter strip research & demonstration site

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Composting is often the preferred technology for solid manure management. Composting reduces odor, stabilizes nutrients, and generates an easily stored product.

While the benefits of composting are well documented, little is known about the water quality impacts at composting sites. This project established a research and demonstration site at the ISU Dairy Farm, Ames, Iowa, to explore these impacts. The primary research objective was to evaluate the effect of a composting/vegetative filter strip (VFS) system on surface runoff of nitrogen (N), phosphorous (P), and sediment after rainfall events. Compost and runoff samples were collected from the windrow composting site during 2002-2004. The study site included nine-6m x 23m (20' x 75') plots with compost placed upslope from the VFS. This project focused on N, P, and sediment total losses contained in runoff that passed through compost: VFS area ratios of 1: 0 (control), 1: 0.5, or 1: 1. Runoff samples for all three treatments were collected from the plots after passing through a tipping bucket system. This system volumetrically measured a runoff sample for each rainfall event. Compost samples also were collected from the windrows and analyzed for moisture levels, pH, electroconductivity, and nutrient and sediment concentrations. All treatments were randomized with three replications for statistical analysis purposes. Analysis results indicated that while high levels of N, P, and sediment were present in the compost and runoff, these pollutants were significantly reduced by VFS buffers. This paper will summarize results from natural rainfall runoff and compost analyses.

Watershed Management/Restoration

Watershed-scale evaluation of selected soil and water conservation practices in the Goodwater Creek Watershed

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In spite of large amounts of funding directed toward the implementation of conservation practices on agricultural land, pesticide, nutrient, and sediment loadings to streams are still high in the Midwestern US claypan region where surface water is the primary source of drinking water. The objective of this study is to characterize the effectiveness of grassed waterways, terraces, filter strips, and buffers in reducing atrazine and sediment loadings in the 27 square mile

Goodwater Creek Watershed in northeast Missouri. This paper describes results from preliminary studies calibrating the Soil and Water Assessment Tool (SWAT) for conditions in this watershed. Specific objectives will detect trends in existing water quality data and utilize SWAT to analyze the impacts of land use and management practices on water quality during the pre- and post-BMP implementation periods. Simulation results will help determine the relative impacts of weather trends and practice implementations on the constituent concentrations. Future work will increase the scope of modeling in several stages, with a goal of understanding how physical, technical, social, and economic factors interact to make certain agricultural practices effective in improving water quality. The project will result in a watershed plan that integrates the findings of this research to address the stream water quality issues and the goals of the watershed stakeholders. Efforts will be conducted to develop and distribute materials and a curriculum for training professionals in reaching farm operators regarding their role in reducing and controlling water quality degradation and for educating local stakeholders.

Relating Herbicide Loadings to Satellite-Derived Land Use on Watersheds with Runoff-Prone Soils

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Water quality of a stream can be affected by the fraction and geographic placement of various land uses, including crop types, within its watershed boundary. Because different herbicides, and different application rates, are used on different crops, the distribution of crop types within a watershed may significantly impact herbicide loadings measured at the watershed outlet. The purpose of this study was to investigate the relationship of crop type and land use, as determined from satellite imagery, to herbicide loadings for several sub-basins of the Salt River watershed in northeast Missouri. Landsat images obtained multiple times during the 1997 growing season were used to estimate land cover and crop types in the watershed. NOAA AVHRR data and ground truth information were used as auxiliary data in the classification process. Water samples were collected at the outlets of seven sub-basins during the period of maximum herbicide transport, from April 15 through July 15. Samples were analyzed in the laboratory for six herbicides

commonly used on corn, soybean, and grain sorghum. Regression analysis was used to relate the fraction of each sub-basin in each crop type and other land uses to the measured herbicide loading. Results were also interpreted with respect to the relative placement of the various land uses within each sub-basin. The results of this study show that land use information estimated from satellite imagery may help to interpret variations in stream water quality.

Disappearance of residual dry matter (RDM) on annual rangelands in the absence of grazing

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Residual dry matter (RDM) is a standard used by grassland managers for assessing the level of grazing use on annual grasslands and associated oak savannas. While RDM is measured at the beginning of a new growing season, grazing does not always occur continuously up to this time. Managers lack information to predict the disappearance of residual dry matter due to physical and chemical breakdown during a period of non-grazing. In this study we investigated the rate of RDM disappearance during the summer (non-growing) period on annual grasslands. The results of our study demonstrate that the amount residual dry matter, by weight, will average a decrease of 7% per 30 day period from the time of peak standing crop of annual herbaceous species to occurrence of the germinating rain in the fall. With the information from this study, grassland managers will be able to determine the amount of herbaceous material that must be left at peak standing crop to insure adequate amounts of residual dry matter at the time of the first fall rains to provide for site protection. In situations where conservative use and a higher residual dry matter standard is appropriate or desired, grassland managers should plan utilizing the higher observed rate of residual dry matter disappearance, 13% per 30 day period.

Plumbing agricultural landscapes for water quality improvement: Coexistence of intensive agriculture and good water quality

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Non-point nutrient export from agricultural watersheds is one of the most important causes of the degradation of freshwater and marine waters. Eutrophication has caused the impairment of waterways in agricultural regions, the increased incidence of harmful algal blooms, and coastal hypoxia. Over the past five years, Iowa State University has been collecting data on water quality measured in lakes at the bases of 132 watersheds across the state of Iowa. This analysis has regional generality because Iowa is the most productive agricultural state in the Mississippi River basin and an important supplier of nutrients to the Gulf of Mexico. Our study watersheds covered 36% of the total land area of the state of Iowa and included >97% of the state's open water surface.

The objective of the study was to identify the characteristics of watershed configuration that have the greatest influence on surface water quality across 132, large, agriculturally-dominated watersheds.

The use of geographic information systems within this project provides a means of assessing the current land use and vegetation configuration and their contribution to water quality within Iowa lakes. A land cover dataset was used to determine a variety of descriptive and functional metrics.

The project outcomes include empirical identification of watershed components and spatial configurations that are most conducive to the maintenance of water quality in Iowa, identification of watershed limitations to intensive agricultural production methods and watershed design criteria required to maintain or enhance surface water quality of Iowa lakes and other surface waters.

Evaluating erosion reducing BMPs using watershed scale water quality data on the Fort Hood military reservation

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Erosion issues associated with intensive training activities on the Fort Hood military reservation were evaluated using watershed scale water quality data. Military training activities on Fort Hood damages and destroys vegetation resulting in soil compaction,

runoff channelization, and gully development resulting in stream and lake sedimentation and training disruptions. We have been monitoring storm discharge, sediment loading and related water quality parameters on Fort Hood since 1995 to determine the effectiveness of ITAM and NRCS implemented BMPs. BMPs include; sediment retention structures, riparian areas, gully plugs, and contour soil ripping. Storm runoff data have proven to be useful indicators of land conditions improved by BMP implementation. Blackland Research and Extension Center (BREC) monitoring stations are instrumented with rain gauges, stream level loggers and stormwater sampling equipment. Sediment concentrations are combined with storm flow volumes to calculate event-specific sediment loads. The differences in storm discharge and sediment loads over time have allowed us to quantify BMP effectiveness. Those implemented in Fort Hood's Shoal Creek Watershed have reduced storm water runoff 60%, sediment concentrations (in runoff) 79%, and average sediment loads over 93%.

Restoration of severely degraded rangeland in the Chihuahuan Desert

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Water is a critical component to range health, especially in arid regions such as the Chihuahuan Desert. A study to determine the feasibility of biodegradable wattles as a restoration technique was implemented in the Terlingua Creek watershed, Brewster County, Texas. Accepted mechanical techniques that are known to reverse site degradation are not applicable on the study site for two reasons: first, the soils are sodic haplocambids which are highly erodible; second, many land management agencies are unable to disturb the soil surface without a cost prohibitive archeological survey. The objective of the study was to increase infiltration rates by slowing down runoff without using an intrusive technique. This was done by laying wattles along contour lines every 33m within the study site. The wattles were constructed from 100% biodegradable burlap bags filled with either cotton burs (gin trash) or cattle manure. Two meter bands above each wattle were harrowed and reseeded with native species. Gerloch runoff samplers were used to measure changes in overland flow and erosion. A pressure transducer measured changes in the water table. Treatment sites were compared to two control sites, one with no manipulation and an-

other with harrowing and reseeding without wattles. Placement of the wattles was shown to reduce overland flow, increase ground water levels and decrease erosion. In conjunction with reseeding, wattles were shown to be an effective means of increasing infiltration rates and increasing vegetative cover on degraded lands that have limited means of reclamation available.

A comparative study of fish assemblages associated with Newbury-Weir riffle pool complexes and natural riffle pool complexes in seven headwater streams of JoDaviess County, Illinois

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Investigations were conducted on fish assemblages in 14 sections of 7 northwestern Illinois, Jo Daviess County, US streams between June of 2003 and August of 2004. Fish were collected using a standard (2.44-meters X 1.52-meters) 0.64 centimeter mesh-stretch minnow seine. The fish surveys yielded 7,581 fish from 25 species and 6 families. Fish collections were analyzed using Simpson's Index of Diversity, Morisita's Index of Community Similarity, and the Mann/Whitney nonparametric U-test.

The project demonstrated that the construction of stone-weir structures (Newbury weirs) in local streams did not impact fish communities. Also, fish communities within Newbury weir sites were not different from communities of natural riffle-pool complexes. Construction of stone-weirs by the Jo Daviess County Soil and Water District (SWCD) and the Streambank Stabilization and Restoration Program (SSRP) resulted in no biologically significant differences in species diversity, community similarity, abundance of stream specialists, or trophic structure. The ecological implications of these structures are discussed with respect to stream restoration and stabilization projects in the state of Illinois and the greater Midwest.

In conclusion, future stream restoration projects should consider Newbury weirs as a stabilization technique and stream restoration practice because they did not affect the fish communities of the streams in this study. However, these structures may negatively impact macroinvertebrate communities, which should be evaluated with future studies.