Illinois Council on Food and Agricultural Research

2007 Annual Report

A Partnership for Illinois Food and Agriculture

C-FAR

Message from C-FAR

Greetings,

We proudly present this 2007 Annual Report of the Illinois Council on Food and Agricultural Research (C-FAR). We do so with a deep appreciation of each C-FAR partner who has made our continued progress possible.

Our pride in C-FAR, and our optimism for the future, rests with the many rich attributes of Illinois. One such attribute is Illinois' research infrastructure. Join us in reflecting on the fact that our state has world-class research institutions – including C-FAR's four university partners – and an extremely qualified and dedicated pool of researchers (including more than 75 Nobel Prize recipients and a myriad of additional nationally and internationally recognized scientists). Illinois additionally possesses abundant natural resources and highly educated, dedicated, and informed food and agricultural industry professionals.

We unequivocally boast the nation's premier public-private food and agricultural research partnership – the State of Illinois and C-FAR. We gratefully acknowledge the State of Illinois for the investments in our state's food and agricultural research programs. We also highly value C-FAR's membership, who represent our state's diverse food and agricultural enterprises, for their valuable guidance to our research priorities and programs. The returns from these investments of funding and talents are immense.

These collective attributes result in a very bright future for Illinois. Our state's infrastructure and partnerships directly pave the way for even greater returns from future research investments. C-FAR, in recognizing its pivotal role in this partnership, fully embraces its legislative responsibility to the State of Illinois and its high public calling, as clearly explained in our mission statement.

Together, as a partnership team, we can and will accelerate the effectiveness of food, agricultural, and related research for the benefit of our state's economy, our number one industry, and yes, every citizen of our great state. Seizing opportunities critical to Illinois will remain our priority, and we will do so with a zeal for the future.

Sincerely,

Alan Puzey
Chairman of the Board

Kraig A. Wagenecht
Executive Administrator

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Our Mission

The mission of the Illinois Council on Food and Agricultural Research (C-FAR) is to advance profitable, consumer-sensitive, environmentally sound food, agricultural, and related systems by securing funding for relevant research and outreach and fostering public participation in program guidance.

C-FAR research funding is provided by the State of Illinois. C-FAR gratefully acknowledges the State of Illinois for these financial investments, which enable advancements in Illinois' food and agricultural industries and significantly contribute to the economic vitality of our state.

Seizing A Strategic Illinois Opportunity

The Illinois Council on Food and Agricultural Research (C-FAR) was founded in 1993 as an Illinois not-for-profit corporation. Its founding principles remain true today – to strategically partner with the State of Illinois, our state's research community, and Illinois' food and agricultural sectors to ensure a viable and robust research program for Illinois' number one industry.

C-FAR anchors this unique partnership with an observant eye towards Illinois' current and future capabilities.

Illinois: Poised for Greater R & D Advancement
Presenting a unique opportunity, Illinois' research and development infrastructure includes

- Four public universities with highly comprehensive food and agricultural programs
- Many additional research-based entities with significant research capabilities strategically located throughout the state
- The nation's largest federal agriculture laboratory (USDA National Center for Agricultural Utilization Research at Peoria)
- Illinois and National Centers for Food Safety and Technology
- Abundant natural resources
- Deep science pool: talented and diverse researchers (more than 75 Nobel Prize recipients)
- Several bioscience commercialization incubators and research parks
- Cutting-edge biotechnology facilities
- Illinois is proudly home to the nation's premier public-private partnership – the State of Illinois and C-FAR. No other state is known to have such a meaningful partnership resulting in the conduct of highly sound and practical research

Food and Agricultural Research in Illinois: National and International Preeminence

Illinois has been a leader in many food and agricultural areas. Publicly-funded research investments continue to be vital to our state's ability to compete and maintain preeminence.

- Today's challenges and opportunities are much different from those of the past
- Illinois' abundant natural resources no longer ensure the state's agricultural preeminence
- Mass production of commodities does not create a competitive edge by itself. Future success depends on adding value to agricultural products and on other advancements
- Highly complex research-based dynamics require interrelationships that continually need to be explored

High Returns from Government Investments

The national social rate of return on government investments in food and agricultural research has been determined to be 45% annually. Each dollar allocated for food and agricultural research returns roughly $10 worth of benefits to the economy (based on 35 comprehensive and peer-respected studies published from 1965 through 2005).

- Returns on investments vary from state to state, with the most efficient returns being realized by those states with higher populations
- Illinois' return on investment is safely assumed to be higher than the national average due to the state's population and infrastructure, and the extremely meaningful engagement of the private sector through C-FAR
- Public agricultural research undertaken today will begin to noticeably influence agricultural productivity in as little as two years, and its impact could be felt for as long as 30 years

Economic analysis finds strong and consistent evidence that investment in agricultural research has yielded high returns per dollar spent. These returns include benefits not only to the farm sector, but also to the food industry and consumers in the form of more abundant commodities at lower prices. – *Economic Research Service, USDA (Economic Brief Number 10) September 2007*

The Research Funding Paradigm

Food and agricultural research programs are funded largely by state governments, federal government, and the private sector (including corporations, foundations, and commodity checkoff programs). An increasing international component is also being realized – in terms of funding and collaborations.

- These sources work in harmony, with state appropriations being the funding foundation that attracts and enables federal, international, and private funding to enhance and expand state-supported research
- The level and effectiveness of state investments directly drives the degree of leveraged federal, international, and private funding realized
- State investments address state-specific needs and opportunities. Agroecological differences, unique populations, and other state-specific factors most often require research to be carried out on a state or regional basis to realize the greatest impact

The C-FAR Appropriations: Characteristics

Beginning in FY96, Illinois began to realize the benefit of a strategically designed State of Illinois appropriation – termed the C-FAR appropriation, via the Food and Agriculture Research Act. State appropriations to support food and agricultural research via C-FAR have the following important characteristics:

- C-FAR appropriations have demonstrably enhanced the vibrancy of Illinois' food and agricultural research programs
- Research is soundly guided, with tremendous industry engagement to ensure that meaningful needs and opportunities are met
- With the State of Illinois, some 100 organizations and public entities are meaningfully engaged in the research priority-setting process (as members of C-FAR)
- C-FAR provides a new transparency of public financial accountability and access to research outcomes
- It is the only state appropriation that provides for a comprehensive and carefully designed research portfolio for Illinois' food, agricultural, and related sectors
- C-FAR has been highly successful in leveraging hundreds of millions of dollars in funding from the federal government, internationally, and from the private sector – funding that further spurs Illinois' economy and that would not have been possible otherwise
- Illinois' current investment in food and agricultural research ranks 9th in the 10 Midwestern states and 22nd nationally

2007 Highlights

C-FAR Appropriation

The State of Illinois enacted a $4.5 million appropriation via C-FAR in FY08 to fund sound food and agricultural research that is highly pertinent to Illinois. C-FAR gratefully acknowledges this investment for all Illinois citizens.

Annual Meeting

The 2007 C-FAR Annual Meeting of the Membership was held during February in Springfield. During the meeting, a special celebration honored Organizational members who have been engaged in C-FAR for 10 or more years. Of the 60 Organizational members, 38 were honored, including 23 charter members. The C-FAR membership elected four individuals to serve on the seven-person 2007 board of directors: Jim Charlesworth, Jerry Hicks, Nels Kasey, and Karen Little. They joined Larry Fischer, Alan Puzey, and Steve Scates. The C-FAR working groups elected chairs, vice chairs, and representatives to the Research Committee to serve in 2007 and 2008. The annual meeting also included presentations by C-FAR-funded researchers on biomass energy crops, Illinois' livestock industry, water quality nutrient standards, farmdoc website, soy-based foods, and livestock manure management.

Charter Organizational members received recognition at the 2007 Annual Meeting.

C-FAR Research Fuels $100 Million Bioenergy Initiative

In February, the energy company BP announced that the University of Illinois at Urbana-Champaign, University of California at Berkeley, and Lawrence Berkeley National Laboratory had been selected to partner in a $500 million research program. The newly established Energy Biosciences Institute (EBI) will focus on exploring how bioscience can be used to increase energy production and reduce the impact of energy consumption on the environment. Illinois will receive about $100 million over the next 10 years to conduct its portion of the research. The C-FAR-funded initiative on biomass energy crops was instrumental in positioning Illinois to be selected for this bioenergy research.

Membership Committee Activated

Given the size and diversity of the C-FAR membership, coupled with the opportunities and responsibilities these members have, the board of directors activated C-FAR's membership committee in 2007. At their first meeting, committee members examined the committee's opportunities and responsibilities, reviewed past and current memberships and related activities, and discussed how to best support members in making their engagement in C-FAR as meaningful and effective as possible.

Water Quality Nutrient Standards Forum

In 2003, C-FAR established its water quality strategic research initiative focused on studying the impact of multiple factors affecting Illinois surface waters and improving the research base to aid in the State of Illinois' development of nutrient standards. An educational forum, open to the public and held during October in Springfield, culminated this three-year research initiative. Over 120 attendees from across Illinois attended the forum.

From left: Drs. Michael Machesky, Walter Hill, George Czapar, Mark David, and William Perry share their SRI research findings during the water quality nutrient standards forum.

Center for Advanced BioEnergy Research (CABER)

The Center for Advanced BioEnergy Research (CABER) at the University of Illinois was recently established to facilitate research and development of the science needed to support the emergence of advanced biofuels and chemicals. Dr. Hans Blaschek, Assistant Dean for Biobased Research in the College of ACES, and professor of food microbiology, provides leadership for the center. C-FAR is pleased to financially support this important initiative through the University of Illinois at Urbana-Champaign's internal C-FAR-funded research program.

C-FAR Day at Illinois State University

C-FAR held its 7th annual C-FAR Day during November at Illinois State University's Farm at Lexington. C-FAR Day provides a unique opportunity for C-FAR members to engage with scientists and hear firsthand about their research activities. During this special event, attendees toured research facilities and learned about a broad range of C-FAR–funded research initiatives being conducted at the university. ISU faculty provided updates on ongoing research and recent achievements in a variety of research areas. C-FAR was pleased to have ISU President Al Bowman welcome C-FAR Day attendees to campus.

Dr. Paul Walker describes research to develop livestock manure processing technologies to C-FAR Day attendees.

2007 Board of Directors and Staff

Board of Directors

Alan Puzey
CHAIRMAN OF THE BOARD,
FAIRMOUNT

Jim Charlesworth
MEMBERSHIP CHAIR,
BLOOMINGTON

Larry Fischer
DIRECTOR,
QUINCY

Jerry Hicks
RESEARCH VICE CHAIR,
SPRINGFIELD

Nels Kasey
VICE CHAIRMAN AND
RESEARCH CHAIR, PARIS

Karen Little
SECRETARY-TREASURER,
PLEASANT PLAINS

Stephen Scates
LEGISLATIVE CHAIR,
SHAWNEETOWN

Staff

Kraig A. Wagenecht
EXECUTIVE ADMINISTRATOR

LeAnn M. Ormsby
COMMUNICATIONS DIRECTOR

Additional C-FAR Staff

Rhonda Barkley
ADMINISTRATIVE ASSISTANT

Gloria Buhrmester
SECRETARY

Arena Jackson
SECRETARY

2007 Working Group Leadership

Expanding Agricultural Markets

Heather Hampton+Knodle
CHAIR, FILLMORE

John Huston
VICE CHAIR, CHICAGO

Rural Economic Development

Kae Hankes
CHAIR, GALESBURG

Norbert Soltwedel
VICE CHAIR, SHUMWAY

Agricultural Production Systems

Molly Ann Godar
CHAIR, ROCHESTER

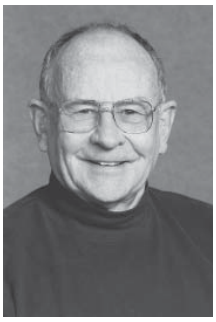
Anne Builta Crider
VICE CHAIR, ARROWSMITH

Human Nutrition and Food Safety

Jeanne Harland
CHAIR, LAFAYETTE

Jim Fraley
VICE CHAIR, COOKSVILLE

Natural Resources and Environment



Byford Wood
CHAIR, BREESE

Dennis Godar
VICE CHAIR, ROCHESTER

Organizational Members

C-FAR Organizational members are nonprofit Illinois organizations that represent varied food, agriculture, and agribusiness interests.

Association of Illinois Soil and Water Conservation Districts

Audubon Council of Illinois

Champaign County Farm Bureau

Dairy Management Inc.

DeKalb County Farm Bureau

DuPage County Farm Bureau

GROWMARK

Horseradish Growers of Illinois

Illinois Agri-Women

Illinois Association of Drainage Districts

Illinois Association of Meat Processors

Illinois Beef Association, Checkoff Division

Illinois Beef Association, Dues Division

Illinois Cooperative Council*

Illinois Corn Growers Association

Illinois Corn Marketing Board

Illinois Dietetic Association

Illinois Farm Bureau

Illinois Farm Business Farm Management Association

Illinois Farm Credit Services

Illinois Farmers Union

Illinois Fertilizer and Chemical Association

Illinois Forage and Grassland Council

Illinois Grape Growers and Vintners Association

Illinois Green Industry Association

Illinois Lamb & Wool Producers

Illinois Landscape Contractors Association

Illinois Milk Producers' Association

Illinois Pork Producers Association

Illinois Pork Producers Association, Checkoff Division

Illinois Restaurant Association

Illinois Seed Trade Association

Illinois Society of Professional Farm Managers & Rural Appraisers

Illinois Soil Testing Association

Illinois Soybean Association

Illinois Specialty Growers Association

Illinois State Grange

Illinois State Horticultural Society

ISU Agriculture Alumni Association

Illinois State Veterinary Medical Association

Illinois Stewardship Alliance

Illinois Turfgrass Foundation

Illinois Wheat Association

Institute of Food Technologists, Chicago Section

Kane County Farm Bureau

Kankakee County Farm Bureau

Knox County Farm Bureau

Madison County Farm Bureau

Mason County Farm Bureau

Mercer County Farm Bureau

Midwest Association of Golf Course Superintendents

Midwest Dairy Association

Orr Agricultural Research Center

SIU College of Agricultural Sciences Alumni Society

The Chicago Farmers

UIUC College of Agricultural, Consumer and Environmental Sciences Alumni Association

UIUC College of Veterinary Medicine Alumni Association

Warren-Henderson Farm Bureau

*New member in 2007

Affiliate Members

C-FAR Affiliate members are largely state and federal agencies, university entities, and other organizations similarly related to the C-FAR mission.

Best Vantage*

Environmentally Correct Concepts

Greene Farm Management Services

Illinois Crop Improvement Association

Illinois Department of Commerce and Economic Opportunity*

Illinois Department of Natural Resources

Illinois Finance Authority

Illinois Forestry Development Council

Illinois Institute for Rural Affairs

Illinois State Geological Survey

ISU College of Applied Science and Technology*

ISU Department of Agriculture

Illinois State Water Survey

Illinois Waste Management and Research Center*

National Center for Food Safety and Technology

NIU College of Health and Human Sciences

Sangamon County Soil and Water Conservation District

SIUC College of Agricultural Sciences

SIUC Department of Agribusiness Economics

SIUC Department of Animal Science, Food and Nutrition

SIUC Department of Forestry

SIUC Department of Plant, Soil and Agricultural Systems

SIUC Illinois Soybean Center

The Nature Conservancy in Illinois

UIUC College of Agricultural, Consumer and Environmental Sciences

UIUC College of Veterinary Medicine

UIUC Department of Agricultural and Biological Engineering

UIUC Department of Agricultural and Consumer Economics

UIUC Department of Animal Sciences

UIUC Department of Crop Sciences

UIUC Department of Food Science and Human Nutrition

UIUC Department of Human and Community Development

UIUC Department of Natural Resources and Environmental Sciences

UIUC Department of Pathobiology

UIUC Department of Veterinary Biosciences

UIUC Department of Veterinary Clinical Medicine

WIU Allison Organic Farm

WIU Department of Agriculture

*New member in 2007

Individual Members

In addition to the Organizational and Affiliate members and all of their representatives, there were 133 Individual members who also supported food, agricultural, and related research in Illinois via C-FAR in 2007.

Committees

Legislative Committee

The charge of this committee is to

- monitor all legislative activity, state and federal, that may have an impact on C-FAR or on its mission and objectives
- develop recommendations for Council or Board approval
- implement and execute plans

Committee Members
Stephen Scates, chair; Constance Locher Bussard; David Downs; David Erickson; Wally Furrow; Jerry Hicks; Karen Little; Alan Puzey; and William Whiteside. *Ex-officio:* Herman Bodewes.

Membership Committee

This committee's responsibilities include obtaining and retaining members, development of consensus measures, and nurturing the support of and engagement in various C-FAR programs.

Committee Members
Jim Charlesworth, chair; Colleen Callahan; Faye Dong; Jack Erisman; Larry Fischer; Roger Hubele; and Tom Toohill.

Nominating Committee

The purpose and charge for this committee includes soliciting and receiving nominations for the board of directors from organizational members, and presenting a slate of candidates to be considered by the C-FAR membership at the annual meeting.

Committee Members
Terry Wolf, chair; Dean Adams; Allan Aves; Bill Campion; Richard Denhart; Charlie Grotevant; William McCartney; and Bob Swires.

Research Committee

The purpose and charge of this committee is to

- inquire into and prepare reports on current and planned research in Illinois on food and agriculture
- seek recommendations on research needs from (a) research professionals currently conducting such research at Illinois universities or elsewhere, (b) interested persons and groups, and (c) the public
- identify research beneficiaries
- prepare recommendations regarding research needs, processes, and impacts, and pursue their implementation as authorized
- foster public confidence in ongoing food and agricultural research by engaging public participation in planning and evaluating the process and impact of research activities

Committee Members
Nels Kasey, chair; Jerry Hicks, vice chair; Susan Adams; Bill Becker; Constance Locher Bussard; Paul Gebhart; Molly Ann Godar; Heather Hampton+Knodle; Kae Hankes; Jeanne Harland; Richard Hull; John Huston; Pat Lawfer; Don Naylor; Jack Norman; Bert Princen; John Quandt; Wendell Shauman; Richard Showalter; William Whiteside; and Byford Wood. *Ex-officio:* William Bailey; George Fahey, Jr.; Jozef Kokini; Robert Rhykerd; and John Russin.

Rules and Procedures Committee

This committee, in consultation with the other committees, monitors C-FAR processes and develops proposals for improvements as needed.

Committee Members
Dennis Thompson, chair; Maralee Johnson; Dan Kelley; Karen Little; Neal Merchen; and Ron Warfield.

Research Partners

University of Illinois at Urbana-Champaign

Robert Easter, Dean

COLLEGE OF AGRICULTURAL, CONSUMER AND ENVIRONMENTAL SCIENCES

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Jozef Kokini, Associate Dean for Research

COLLEGE OF AGRICULTURAL, CONSUMER AND ENVIRONMENTAL SCIENCES

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

George Fahey, Jr., Assistant Dean, Research Leadership–C-FAR

COLLEGE OF AGRICULTURAL, CONSUMER AND ENVIRONMENTAL SCIENCES

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Southern Illinois University Carbondale

Gary Minish, Dean

COLLEGE OF AGRICULTURAL SCIENCES

SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

John Russin, Associate Dean for Research and Personnel Administration

COLLEGE OF AGRICULTURAL SCIENCES

SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

Illinois State University

Robert Rhykerd, Interim Chair

DEPARTMENT OF AGRICULTURE

ILLINOIS STATE UNIVERSITY

Western Illinois University

William Bailey, Chair

DEPARTMENT OF AGRICULTURE

WESTERN ILLINOIS UNIVERSITY

In addition to these primary research partners, C-FAR is pleased to work with a number of additional research related entities.

Research Programs

C-FAR research programs are carefully developed to provide a comprehensive and well-balanced research portfolio. Every initiative is identified, funded, and carried out based on a highly deliberate set of research priorities representing the needs and opportunities of Illinois. Brief descriptions of the three research programs follow.

Strategic Research Initiative Program

The Strategic Research Initiatives (SRIs) are highly collaborative team-based research initiatives that provide a targeted, multidisciplinary, and multi-institutional approach for addressing major issues and concerns of Illinois' food and agricultural industry and consumers. These initiatives address longer-term needs and opportunities.

University Internal Programs

In accordance with the Food and Agriculture Research Act, the majority of research funds are allocated on a percentage basis to Illinois' four universities with food and agricultural research programs: the University of Illinois at Urbana-Champaign (Illinois Agricultural Experiment Station) (82%), Southern Illinois University Carbondale (11%), Illinois State University (4%), and Western Illinois University (3%). Each university solicits requests for proposals (RFPs) as part of an internal competitive grants program to select innovative, high-quality research that addresses the needs of the Illinois food, agriculture, and related communities and consumers as defined by the C-FAR membership.

In 1999, the University of Illinois initiated its C-FAR Sentinel Program as part of the university's internal research program. The Sentinel Program's purpose is to take advantage of opportunities for performing creative, problem-solving research.

External Competitive Grants Program

C-FAR's External Competitive Grants Program is designed to encourage and support research efforts from nonprofit institutions, organizations, and agencies throughout Illinois. The program solicits RFPs from Illinois nonprofit research entities. By legislation, a minimum of 15% of the C-FAR appropriation is allocated to this program.

Working group participants review and select proposals submitted to this program for funding. Proposal review follows a two-step process. The first step is a request for, and review of, pre-proposals. C-FAR working group participants evaluate pre-proposals based on relevance to C-FAR research focus areas, potential outcomes and benefits to stakeholders, and dissemination plans. The second step involves inviting principal investigators of top-ranking pre-proposals to submit full proposals.

Strategic Research Initiative Program

In 1998 the C-FAR membership established the Strategic Research Initiative (SRI) Program to implement a targeted, multidisciplinary, and multi-institutional team approach to addressing major research needs and opportunities for Illinois' food, agriculture, and related sectors and consumers. The following are highlights of FY07 progress reports submitted by the principal investigators of active SRIs. A third SRI, focused on water quality nutrient standards, concluded during the year. A summary of the final report for this initiative follows.

Biomass Energy Crops for Power and Heat Generation in Illinois: Diversifying Cropping, Improving Energy Security, and Benefiting the Environment

Dr. Stephen Long, professor of crop sciences and plant biology at the University of Illinois at Urbana-Champaign, provides leadership for a multidisciplinary team of researchers working to provide Illinois with the foundation and technology leadership for the large-scale cultivation of biomass crops. In this five-year SRI, researchers are focusing on the use of Miscanthus (*Miscanthus x giganteus*), a perennial rhizomatous grass, as a potential renewable energy source for Illinois and as a profitable alternative crop for Illinois agricultural producers.

Principal Investigators

Stephen P. Long – Crop Sciences and Plant Biology

Yuanhui Zhang – Agricultural and Biological Engineering

Madhu Khanna – Agricultural and Consumer Economics

Michael S. Katterhenry – Animal Sciences

German A. Bollero, Jack M. Widholm – Crop Sciences

Anne Heinze Silvis – Human and Community Development

Mark B. David, Jack A. Juvik, Gregory F. McIsaac, Thomas B. Voigt, Michelle M. Wander – Natural Resources and Environmental Sciences

Frank G. Dohleman – Plant Biology

University of Illinois at Urbana-Champaign

Field Trials

Large plots at University of Illinois South Farms are expected to reach maturity in the summer of 2008. Yield analysis continues in the small (0.25 acre) trials established at Dixon Springs, Urbana, and DeKalb. Averaged across the three sites, peak dry mass of Miscanthus vs. switchgrass was 21 verses 7 tons/acre in 2004 (a wet year), 14 verses 3 tons/acre in 2005 (a dry year), and 19 verses 5 tons/acre in 2006 (an average year). Identical trials have now been established at Fairfield, Brownstown, Orr, Pana and Havana, covering a wider range of Illinois soils and site conditions.

Yield models are being improved by including photosynthesis, soil types, and climate variables. Daytime photosynthesis measurements have shown that when averaged over two growing seasons, Miscanthus upper-canopy leaves have 33% higher daily carbon uptake than switchgrass. Nitrogen trials have shown that in Urbana where soils are fertile, there is no response of yield for Miscanthus to nitrogen. However in Orr, on more sandy soils, there was a slight response to nitrogen. Researchers are continuing to conduct nitrogen trials at all sites throughout the state.

Miscanthus Breeding and Improvement

Researchers are investigating ways to provide genetic diversity and the basis for breeding higher yielding and better adapted forms of *Miscanthus x giganteus* for Illinois. Numerous greenhouse hybridizations between the parental species of *M. x giganteus (M. sinensis and M. sacchariflorus)* have been conducted without successfully generating any viable seed. Researchers are working with North Carolina State scientists who have developed a procedure for embryo rescue from crosses between these species.

Researchers are attempting to double the chromosome number of *M. x giganteus* to convert it from a triploid to a hexaploid plant, which could potentially increase vegetative growth and biomass and promote conventional breeding. *Agrobacterium*-mediated transformation studies are also being conducted. Transgenic Miscanthus with resistance to herbicides would be of value for weed control in the first and second years of stand establishment. Genes from Miscanthus involved in biomass yield and ethanol conversion efficiency are being isolated and studied. *M. sinensis*, another species of Miscanthus, is being investigated for feedstock production.

Development of Genetic Engineering Techniques

Transformation efforts have been carried out using both *Agrobacterium tumefaciens* and particle bombardment methods. In the spring of 2006, 55 regenerated plants were planted and 54 survived and grew to about 2 m in height and flowered. Despite their impressive growth, 12 did not survive the winter. Researchers are continuing to regenerate plants to transplant at different times during the summer to monitor survival. A transformation system will allow one to genetically alter a number of traits such as cell wall composition, cold tolerance, pest resistance, flowering, and growth rate.

Soil Carbon and Gas Emissions

After four years, Miscanthus and switchgrass have been shown to sequester carbon at 0.13 tons/acre/yr and 0.09 tons/acre/yr, respectively. Researchers found that row crop systems have positive global warming potentials and that warming is less under the soybean phase of the rotation. Bioenergy crops have negative global warming potentials because they sequester soil organic carbon. The magnitude and pattern of trace gas flux were generally similar in 2005 and 2006; exceptions were: N_2O flux from Miscanthus plots was reduced in 2006 relative to 2005 due to drier soil conditions, N_2O flux was similar from switchgrass and soybean plots, and flux from bioenergy plots increased in fall. The contributions of soil organic carbon sequestration to ecosystem services (soil productivity and erosion reduction) are likely to be as or more valuable than climate offsets. The data now provide evidence that both Miscanthus and switchgrass are net absorbers of greenhouse gases, and should therefore merit any credits provided to farmers for climate change mitigation, and suggest that Miscanthus is a superior choice based on soil organic carbon sequestration potential.

Water Resource Implications

Water usage and nitrogen leaching in biomass crops is being evaluated and contrasted against a conventional corn and soybean rotation. Results indicate that Miscanthus and switchgrass would greatly reduce nitrate losses in drainage water, providing an important water quality benefit. On the other hand, Miscanthus appears to use considerably more water than switchgrass or corn, which could reduce stream flows and extend periods of low flow, in some growing seasons and in watersheds where Miscanthus constitutes a major land cover. The reduced flows can provide both benefits (flood reduction) and costs (reduced surface water availability for other uses).

Propagation and Eradications of *Miscanthus X Giganteus*

Miscanthus rhizomes were evaluated for cold tolerance, optimal rhizome size, and optimal rhizome planting depth. When stored at 39°F for up to 4 months, rhizome survival ranged from 83% to 100%. Researchers recommend using 50g rhizomes planted approximately 4 inches deep. In weed control studies, none of the pre-emergence and post-emergence corn herbicides, or combinations, caused

unacceptable phytotoxicity to the Miscanthus plants and there were no statistical differences among treatments.

Harvesting and Preprocessing Technologies

Miscanthus has been shown it can be harvested using conventional harvesting equipment, however it currently involves approximately three times the time commitment and harvesting costs as is required for a traditional hay harvesting operation. Researchers are investigating ways to improve overall harvesting efficiency. Pellets are being made from both the switchgrass and the Miscanthus for use in biomass furnaces.

Thermochemical Conversion of Biomass to Fuel

Miscanthus has been successfully converted into a crude oil at 38% efficiency (dry mass) with the presence of a catalyst. At lower temperatures, researchers obtained 10% of 5-carbon and 6-carbon sugars, and up to 90% of total mass was hydrolyzed. They also found that a multistage hydrothermal process may be able to rapidly depolymerize lignocellulos as a pretreatment, yet prevent fermentation inhibitor production. It appears that a multistage thermochemical conversion process is best for obtaining high sugar yield and crude oil. The process could be used to obtain oils from Miscanthus with a positive energy balance. Thermochemical conversion methods can relatively quickly destruct the lignocellulose, opening access to other reactants such as enzymes.

Economic Analysis

The profitability of growing bioenergy crops varies depending on soil conditions, climate, and location relative to markets and depending on the age of the perennial crops. It also varies with the costs of the land use and transportation costs. Based on current conditions, analysis indicates

- The minimum price of bioenergy needed to make it profitable for landowners to produce Miscanthus is $42 per metric ton; at this price only about 1,630 acres of Miscanthus and no switchgrass would be planted.
- The maximum price that power plants would be willing to pay for bioenergy based on its coal equivalent heating value is about $20 per metric ton. This implies the need for a minimum subsidy of $22 per metric ton. At prices of $50 and $58 per metric ton, the amount of cropland that would be allocated to Miscanthus increases to 1% and 1.5% respectively. Miscanthus grown on this land could generate 2.5% and 4%, respectively, of electricity in Illinois if there is a limit of 5% for the extent to which bioenergy can be cofired with coal. Even at these prices, the percentage of electricity that can be generated using bioenergy increases to 6% and 12%, respectively, if the percentage of cofiring increases to 25%.
- Bioenergy from Miscanthus has the potential to reduce carbon emissions by 12% and to reduce sulfur dioxide emissions by 2%, if the price of bioenergy is $50 per metric ton and the limit on cofiring is 5%. These percentage reductions in emissions are 15% and 4%, respectively, if the price of bioenergy increases to $65 per metric ton.
- A 25% reduction in harvesting costs could make it profitable to almost double the land allocated to Miscanthus production.
- At a bioenergy price of $50 per metric ton, the maximum distance it would be profitable to transport Miscanthus for electricity generation would be 33 miles.

This research shows that with current low prices of coal, bioenergy crops are unlikely to be competitive as sources of fuel for electricity generation unless their environmental benefits, particularly in the form of carbon emissions reduction, is valued. Additionally, it shows that technological advances in the cofiring of bioenergy crops with coal and reductions in Miscanthus production costs could substantially increase the amount of land allocated to bioenergy crops.

Social Acceptability of Energy Crops

Mail surveys and focus groups were conducted targeting farming populations from across Illinois. Results reveal that regarding Miscanthus, the most important areas of interest among producers include

- Production practices: equipment needs, information about storage and harvesting, soil fertility requirements, availability of material to plant, specific production practices, and potential pests and diseases
- Environmental issues: effects on water quality and soil quality, improving national energy security, reducing CO_2 emissions and nitrogen runoff, and producing a visually attractive crop
- Concerns and potential problems: concern about Miscanthus becoming a weed, experience growing Miscanthus in Illinois or their own region, changing the operation's current crop rotation, unfamiliarity with growing a perennial crop, the existence of long-term contracts to grow Miscanthus, and crop insurance
- Markets and marketability: market potential, prices, demand, data, and existing markets
- Inputs reduction: opportunity to reduce inputs of fertilizer, pesticides, and fuel in producing a crop and the opportunity to reduce labor and wear and tear on equipment

Illinois Livestock Integrated Focus Team (IL LIFT)

Dr. Michael Hutjens, professor of animal sciences at the University of Illinois at Urbana-Champaign, leads a multidisciplinary, multi-institutional research team addressing the economic and social challenges facing Illinois' livestock industry. The four-year SRI focuses on livestock facility siting in Illlinois; using Illinois byproduct feeds in livestock feeding programs; pasture-based forage systems to sustain Illinois livestock producers; and animal identification for enhanced food quality and monitoring of livestock health. Researchers received a no-cost extension in 2007 to bring the initiative to full fruition.

The SRI website, titled Illinois Livestock Trail and located at www.livestocktrail.uiuc.edu, was redesigned in 2007 and joined the suite of University of Illinois Extension websites. This website continues to provide the extension and outreach platform for the IL LIFT SRI initiatives.

Principal Investigators

Michael F. Hutjens – Animal Sciences

Larry L. Berger – Animal Sciences

Ted L. Funk – Agricultural and Biological Engineering

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Justin W. Sexten – Animal Sciences
University of Missouri (formerly of University of Illinois Extension)

Livestock Facility Siting in Illinois

As Illinois livestock operations modernize and expand, they face requirements for manure handling, consumer acceptance, community reaction, and economic impact on their facilities. Researchers are investigating compliance by current livestock facilities, reasons for noncompliance, and ways to improve compliance and its impact on the community.

In 2006, researchers completed the on-farm survey of livestock manure nutrient management plans and practices. The findings of the surveys were incorporated into the livestock producer certification training program. Eleven workshops were held throughout the state from December 2006 to March 2007. A total of 304 producers, contractors, educators, and others participated in the workshops. During the next year, researchers will assist livestock producers in writing their Comprehensive Nutrient Management Plans so those producers can take advantage of the new round of USDA Natural Resources Conservation Service incentive payments. Up to 100 livestock producers are expected to benefit from this program, which will utilize the newly developed Illinois Manure Management Plan (IMMP) website located at https://webs.extension.uiuc.edu/immp.

Using Illinois By-Product Feed in Livestock Feeding

New ethanol plants are being constructed and going into production, making byproduct feeds more abundant. Researchers developed an interactive website to inform Illinois livestock producers about the use of dried and wet distiller's grains in livestock diets. Information on distiller's grains and their utilization in livestock diets is available at http://ilift.traill.uiuc.edu/distillers. Information on ethanol plants in or within a 100 mile radius of Illinois is also provided with a contact person, yearly production of distillers grains, products available, pricing structure, nutritive value/specifications, minimum load, and their website (if available).

Using Illinois Forages Based on Pasture-Based System

This project focuses on determining the economic value of integrating animal grazing systems into conventional short-term crop rotation. Forage testing indicates forage quality of managed grazing systems is sufficient to maintain a cow-calf enterprise. High-production enterprises such as lactating ewes and dairy cows or growing calves may require energy supplementation to support desired performance. While economic data analyses are ongoing, preliminary results suggest complete utilization of annual forages are required to compete with perennial forages. All field research can be monitored at www.livestocktrail.uiuc.edu/pasturenet. Pasture initiative data collection concluded during 2007 with future activities focusing on data summarization and dissemination.

Animal Identification for Enhanced Food Quality and Monitoring Livestock Health

Animal identification to improve animal health, provide traceability of livestock products, and enhance food quality is a national concern. Micrometer-scale electronic devices are being tested as a method for permanent animal identification and physiological monitoring, with an emphasis on body temperature tracking in real time.

Previous work confirmed that ID devices that also measure body temperature could be used to track fever as an indicator of animal disease. However, those data were generated using an experimentally induced fever model. Researchers also examined the utility of temperature measurement as a predictive aid to producers for disease incidence in animals under natural conditions, specifically around parturition in dairy cattle. Results from that study indicate that the sampling frequency needs to be increased to reliably predict disease events around parturition. In addition, there are external factors that influence data measurement that need to be included in any model ultimately used to evaluate the data streams resulting from temperature measurement. This past year, the ID devices were evaluated in steers during a controlled heat stress event with an experimentally induced fever. This data suggests that individual animal response is important when developing models that identify disease events. A producer survey was distributed to Illinois livestock owners in January 2007. A summary of survey respondents is located at www.livestocktrail.uiuc.edu.

Water Quality with a Focus on Nutrient Standards

This initiative focuses on improving the research base to aid in the State of Illinois' development of nutrient standards for Illinois surface waters. Dr. George Czapar, University of Illinois Extension educator, provides leadership for the SRI. The research team works closely with the Illinois Environmental Protection Agency, Illinois Department of Agriculture, Metropolitan Water Reclamation District of Greater Chicago, and others. Having received a no-cost extension to complete necessary research and related analysis, the SRI formally ended in 2007. The following is a summary of the final report provided by investigators.

Principal Investigators

George F. Czapar
University of Illinois Extension

Walter R. Hill, Timothy B. Smith – Aquatic Ecology
Illinois Natural History Survey

William L. Perry – Biological Sciences
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Michael L. Machesky, James Slowikowski – Watershed Science
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Indiana University (formerly of NRES at UIUC)

Matt R. Whiles – Zoology
Southern Illinois University Carbondale

Mark B. David – Natural Resources and Environmental Sciences
University of Illinois at Urbana-Champaign

Nutrients, Chlorophyll, and Dissolved Oxygen in Illinois Streams

A combination of state-wide surveys and smaller-scale, intensive studies were used to address questions of nutrient-algal-oxygen relationships across Illinois. These studies found complex relationships at each step of the conceptual model relating nutrients to biotic integrity of streams. Many factors were confounded, which made it difficult to clearly document the role of nutrients. Few streams and rivers in Illinois have low nutrient concentrations, making it difficult to find strong relationships. In addition, physical habitat was often degraded and this appeared to be the major limit to biotic integrity. Overall, nutrients appeared to seldom be limiting to algal biomass, and other factors such as substrate, light, or residence time were limitations.

Researchers have proposed two decision tree analyses to support a conceptual framework, and suggest that the framework could be used to classify streams and decide which streams are likely affected by nutrients. The first decision tree accounts for reservoir or lake chlorophyll-*a* sources, nutrients, stream cover, and turbidity in classifying streams. The second decision tree uses patterns in dissolved oxygen to identify sites where nutrients are likely to be important. Given the many factors that influence all aspects of the nutrient to chlorophyll-*a* to dissolved oxygen to biotic integrity pathway, it is difficult to isolate the role of nutrients in Illinois streams and rivers. These results have indicated the complexity of these relationships, but have provided a valuable basis for developing a strategy for determining where and when nutrients might be important.

Effects of Phosphorus Mediated through Algal Biomass in Illinois Streams

Researchers sought to quantify the effects of phosphorus on algal biomass and associated parameters in order to provide a scientific basis for establishing nutrient criteria. Research was based on the conviction that understanding the quantitative response of stream algae to phosphorus concentration is essential to setting quantitative standards. The quantitative relationship between phosphorus and algal biomass and associated parameters was explored in four different subcomponents, each of which represented a different scale of investigation.

Data Mining

Biological data sets from the Illinois Department of Natural Resources and Illinois Natural History Survey were linked to water quality data in the Illinois Environmental Protections Agency's Ambient Water Quality Monitoring Network in order to explore statistical relationships between plant and animal life and water quality variables. Relationships were explored between fish and bivalve mollusk diversity and dissolved phosphorus and ammonia.

Extensive Surveys

Water quality, habitat, and benthic algal parameters were measured repeatedly at a variety of Illinois streams. No statistically significant relationship was observed between benthic algal biomass and streamwater phosphorus concentration, despite uniform substrata and consistent sampling technique.

Large-scale Single Watershed Experiment

This project exploited the gradient of phosphorus loading caused by the establishment of the new Bloomington Wastewater Treatment Plant on Little Kickapoo Creek in McLean County. Sampling stations were established at 10 sites on the stream, five upstream and five downstream of the plant. Sampling commenced one year before the plant began discharging phosphorus-laden water and continued for two years afterwards. Artificial substrata were deployed at six separate locations at each site chosen to maximize diversity in the exposure to sunlight. Results indicate benthic algal biomass (chlorophyll-*a*) was strongly related to light regime and current velocity, and only weakly related to total phosphorus in multiple regression analysis. Algal phosphorus content was significantly related to both dissolved phosphorus concentration and canopy cover.

Experimental Streams

Large indoor streams at the Oak Ridge National Laboratory were used to perform controlled experiments in which stream algae were grown under a range of specific phosphorus concentrations and light regimes. Controlled conditions (constant phosphorus concentrations, regimented lighting, no spates, no macrograzers, etc.) resulted in precise quantitative relationships between algae and phosphorus in all experiments. Results strongly suggest that a phosphorus standard greater than or equal to 25 $\mu g\ L^{-1}$ dissolved reactive phosphorus will do little to constrain algal growth in streams. Light manipulations produced larger effects on algal growth than did phosphorus, indicating the potential for light effects to mute phosphorus effects in natural streams.

Seasonal Dynamics of Nutrients, Algae and Dissolved Oxygen in Agriculturally Dominated Headwater Streams: the Link Between Land-Use and Water Quality

The relationship between nutrient concentrations, algal biomass, and dissolved oxygen was examined in six agriculturally dominated headwater streams and the Mackinaw River covering a range of low to high phosphorus concentrations. Nitrogen and phosphorus were found to vary seasonally in response to changing discharge. High nitrate concentrations observed from mid-October through mid-June decreased to near detection limits while phosphorus concentrations peaked during spring and fall flood events and varied among streams due to differences in watershed management practices.

Seasonal variation in algal biomass in the streams was examined to determine when biomass was the highest and if the periphyton was nutrient limited by either nitrogen or phosphorus. Weak nitrogen limitation was observed during summer periods, but phosphorus limitation was not noted even in the lowest phosphorus systems. Highest algal biomass was observed in January as well as late summer and was associated with stable flow regimes. Periphyton productivity on hard and soft substrata was not significantly different over the range of phosphorus concentrations, but respiration rates were significantly higher on soft sediments and may contribute significantly to low dissolved oxygen concentrations. Chlorophyll-*a* concentrations on soft substrata were significantly higher due to inactive, buried periphyton that was not photosynthetically active. The results of these studies suggest that periphyton over this range of phosphorus concentrations are not nutrient limited and in all systems dissolved oxygen fluctuations led to low dissolved oxygen during low flow periods.

The Impact of Sediments on the Potential Bioavailability of Phosphorus in Illinois Streams

Stream water bioavailable phosphorus concentrations were determined using filter paper discs coated with iron-oxide, which adsorbs both dissolved reactive phosphorus and bioavailable particulate phosphorus. Of the bioavailable phosphorus fractions, average dissolved reactive phosphorus concentrations were greater than those of bioavailable particulate phosphorus. In addition, mean bioavailable phosphorus concentrations were always considerably lower than inert particulate phosphorus concentrations. Particulate phosphorus becomes less bioavailable as it is transported downstream in this watershed. Researchers also determined that stream bottom sediments are neither an important source nor absorbant of bioavailable dissolved reactive phosphorus for the overlying stream water.

The increase of nutrient impacts are most evident between about mid-April and mid-October because stream water temperatures are higher, days are longer, and stream flows are generally lower, all of which promote the growth of algae and corresponding large daily swings in dissolved oxygen concentrations. Low flow conditions accompanied higher suspended chlorophyll-*a* or algal biomass concentrations, and lower dissolved reactive phosphorus concentrations since the greater algal biomass utilized more dissolved reactive phosphorus and was not periodically “flushed” downstream as happens during more normal flow regimes.

Benthic algal populations are usually greater than those suspended in the water column in small to medium-sized streams and rivers. However, the amounts found on the soft silt/clay sediments were somewhat surprising, especially since those sediments are easily washed away in higher flows. One possible reason for this abundance is that benthic algae are able to obtain at least part of their nutrient requirements from the sediments themselves. Diurnal swings in dissolved oxygen were observed during all times of the year provided flows were low and stable. However, the diurnal swings were greatest between about mid-June and mid-October, in response to higher water temperatures and longer days. In addition, researchers observed abrupt increases in stage flushed algae downstream which resulted in dampened dissolved oxygen fluctuations. These flushing events “reset” the streams to a relatively less eutrophic state. However, diurnal dissolved oxygen fluctuations, and hence algal productivity, rebounded to pre-storm levels in about one week’s time, indicating that the effect of storms was only temporary.

Internal and External Research Projects: Final Report Summaries

The following section includes summaries of final reports submitted by the principal investigators of University Internal Program projects and External Competitive Grants Program projects that were completed in 2007. Please visit the C-FAR website at www.ilcfar.org/research/index.html for more detailed information on these projects.

Crops

Exploiting GDHA+ Corn to Control Aflatoxin Contamination in Infected Kernels

Corn ear rot caused by the filamentous fungi *Aspergillus flavus and Aspergillus parasiticus* remains a potential problem for corn growers in Illinois and in other corn growing regions in the U.S. Ear rot on corn is often associated with an accumulation of aflatoxins in infected kernels. Aflatoxins are of particular concern as food contaminants because they are highly carcinogenic. One of these compounds, aflatoxin B1, is the most potent naturally occurring carcinogen that has been isolated to date.

Researchers have developed corn lines that express a bacterial NADP (nicotinamide adenine dinucleotide phosphate)-dependent glutamate dehydrogenase *gdhA* gene. Lines with glutamate dehydrogenase-specific activity showed tolerance to gluphosinate-type herbicides. They also showed increased grain biomass production in dry environments associated with increased water deficit tolerance. The main objective of this research is to investigate the "resistance" of the developed *gdhA*+ corn lines to the accumulation of aflatoxin B1. This will lead to the identification of specific markers to be used in breeding programs aimed at reducing or eliminating aflatoxin B1 in corn.

A total of 14 corn lines were assessed for *A. flavus* colonization and aflatoxin B1 accumulation during the 2006 and 2007 growing seasons. Six of these lines, 4 hybrids and 2 isolines, were transgenic expressing the *gdhA* gene. The plants were planted in single-row plots with 12 plants per row. Plots were arranged in a randomized complete block design with two replications. Primary ears of each plant were inoculated 20 days following the midsilk growth stage with a conidial suspension of *A. flavus* isolate NRLL3357 using the pinbar method. Ears were harvested 60 days after midsilk and visually rated for rotting. Wounded kernels from the inoculated area of the ear and the surrounding two rows were manually collected and analyzed for aflatoxin B1 using High Pressure Liquid Chromatography (HPLC). Researchers observed up to 56% reduction in fungal colonization in transgenic, *gdhA*+ expressing lines. HPLC analysis showed that *gdhA*+ expressing lines had up to 70% less accumulated aflatoxin compared to lines not expressing the *gdhA* gene.

SIUC Internal Program

Ahmad M. Fakhoury, David A. Lightfoot – Plant, Soil, and Agricultural Systems

Southern Illinois University Carbondale

Expanding the Demand for Illinois Corn: High Speed Rail Loading Facilities Impact on Corn Prices

The Southeastern United States rail market has been a traditional outlet for Illinois corn; however, as more corn west of the Mississippi is being redirected to ethanol production, the Southwest cattle feeding market has become an attractive market destination for Illinois corn. To service this market a small number of country elevators, in cooperation with the Burlington Northern Santa Fe Railroad, have constructed what are termed high-speed shuttle loaders. These are grain elevator facilities that have the capacity to load 110 car shuttle trains within an eight to fourteen hour time frame. To speed the loading process, the hopper cars and the locomotive remain connected and the train itself is turned over to elevator personnel for the loading of the grain. The train is sided to a one mile long loop of track. Each hopper car can hold about 4,000 bushels of corn, thus a 110 car shuttle requires about 440,000 bushels. A hopper car can be loaded in approximate 4-7 minutes. The purpose of this research is to determine the impact of the introduction of these high-speed rail loader facilities on corn prices in their service region.

A paired t-test was used to compare daily spot cash prices of the high speed shuttle train loader with its competitors prior to the high-speed facility coming on line and then after the facility came on line. The available price data was not uniform for all elevators, thus the number of price points varies as various high-speed loaders are compared to their competitors. The impact of the construction of a high-speed rail loading facility on area corn prices is significant. The spot cash bid for corn at the grain elevators constructing high-speed facilities appears to have improved from $ .04/bu to $ .10/bu. This likely underestimates the true impact on local prices as other local elevators increase their bids in order to compete with the high-speed loaders.

ISU Internal Program

Rick C. Whitacre – Agriculture

Illinois State University

Expanding the Demand for Illinois Corn: The Impact of New and Expanded Ethanol

The focus of this study was to determine the impact expanding ethanol production has on local corn prices. It was anticipated that given the quantity of corn needed to justify the expense of these multimillion dollar facilities, higher prices will need to be offered producers to originate the necessary grain. The impact of higher grain prices would affect local farm income and land prices. Local

competitors of the facilities will also be impacted. These competitors will likely experience higher grain origination cost while having to rely on their traditional market outlet.

This study examined the impact of two producer owned ethanol facilities on the price of corn in their local market relative to a designated terminal market (a river bid in one case and a rail bid in the other). Each of these facilities is producing approximately 50 million gallons of ethanol annually. Fifty million gallons of ethanol equates to about 18 million bushels of corn. One of these facilities began processing in 2002 and the second began processing in 2003.

Daily basis (the difference between cash and futures prices) was calculated for each facility over a crop or market year. The differences were statistically analyzed to determine if there is a significant difference between terminal bids. An examination of basis did not show that there was a statistically significant improvement in local basis compared to the basis at terminal markets. However, an analysis of the data does indicate that volatility of the price variation between terminal markets and markets near the ethanol facilities does increase significantly.

ISU Internal Program

Rick C. Whitacre – Agriculture

Illinois State University

Research and Discovery Program to Abate the Threats and Harness the Potential of Atmospheric Change to Benefit Illinois Agriculture (SoyFACE)

A unique open-air laboratory was established to determine the effects of rising atmospheric carbon dioxide and surface ozone on crops under fully open air conditions. Researchers are investigating the effects of atmospheric change on the yield of soybean and corn, the underlying physiological and molecular mechanisms, and effects on the agroecosystem as a whole. They are working to discover genetic variation in response within the two crops and to determine how adaptation to the future may be achieved. The open-air laboratory established on 80 acres of the University of Illinois at Urbana-Champaign (UIUC) South Farms is the largest Free Air Concentration Enrichment (FACE) facility in the world. The ozone treatment was an entirely new innovation, and the technology developed is now being duplicated in China.

Contrary to smaller scale laboratory and field enclosure studies, researchers have found that the yield increase due to increase in carbon dioxide to projected 2050 levels, was only 14% in soybean and not the forecast 30%. In corn, it was 0%, and not the forecast 15%. By contrast the experiment showed that current levels of surface ozone are decreasing the yield of soybean by 15–20%, and that there was no improvement in tolerance with cultivar release date. However, variation in resistance was detected within the National Soybean germplasm collection, providing a basis for breeding tolerance. With projected increases to 2050, yield loss could rise to 30% unless new resistant cultivars can be developed.

Several unexpected effects of elevated future carbon dioxide were found. Damage by Japanese beetles doubled, while the Western Corn Rootworm variant laid twice as many eggs in soybean grown in elevated carbon dioxide. Genes associated with this decreased pest resistance have been identified. 2050 levels of carbon dioxide slowed crop development and crop maturation by 2-5 days and decreased the quality of soybean, particularly with respect to micronutrient content. The soil microbial community has been altered very substantially by six years of elevated carbon dioxide.

Over 20 research groups from UIUC covering 10 departments and three colleges have conducted research in SoyFACE. In addition, 24 groups from other U.S. universities and research institutes and 21 groups from universities and institutes outside of the U.S. covering 15 countries have worked in the facility. This represents a very substantial no-cost leveraging of external expertise.

Researchers have obtained over $9.5 million in additional funding or in-kind support from the U.S. Department of Energy, National Science Foundation, USDA NRI/ARS, Argonne and Brookhaven National Laboratories, BASF, ADM, and Pioneer Hi-Bred in support of and to continue this research.

UIUC Sentinel Program

Stephen P. Long, Donald R. Ort – Crop Sciences and Plant Biology

Evan H. DeLucia – Plant Biology

University of Illinois at Urbana-Champaign

Development of a Soybean Cyst Nematode Genetic Infrastructure

The focus of this project was to develop tools to allow for the genetic analysis of soybean cyst nematode (SCN) virulence and other important traits. Research objectives were to (1) discover genomic sequence polymorphisms between SCN biotypes that could be used as molecular markers, and (2) devise a high throughput method to discover and use these sequence polymorphisms.

To discover SCN sequence differences between two different SCN inbred lines (one virulent SCN line and one non-virulent SCN line), researchers conducted high throughput DNA sequencing on the two biotypes. By comparing the low copy sequence data between these SCN lines, 8,044 single nucleotide polymorphisms (SNPs) were discovered. Insertion deletion mutations were not reliable, thus researchers focused on SNP polymorphisms. A subset of SNPs were verified by re-sequencing and 77% of the predicted SNP were found to be correct. This implies that 6,193 of the SNPs discovered could be expected to be correct. In the next phase of the project, researchers converted the putative SNPs into quantitative genotyping assays. A real time PCR-based assay was devised to measure SCN SNP allele frequency in SCN populations. Researchers have designed 239 SNP assays to date and found a 78% conversion rate from a confirmed SNP to a functioning genotype assay. Prior to the initiation of this project, there was only one published SNP between SCN biotypes. At the end of this project, researchers now have thousands of putative SNPs, and enough confirmed SNPs and functioning assays to conduct an initial screen of SCN mapping populations to find SNPs linked to the virulence phenotype. The ability to map and clone SCN virulence genes is very important in controlling SCN and the success of this project has provided tools to accomplish this goal.

UIUC Sentinel Program

Kris N. Lambert, Terry L. Niblack, Matthew E. Hudson, Leslie L. Domier – Crop Sciences

University of Illinois at Urbana-Champaign

Synthesizing Biodiesel from Agricultural Waste Using Biocatalyst and Ethanol

The objectives of this project were to characterize the quality of Illinois State University (ISU) campus waste vegetable oil, test the feasibility of establishing a campus-wide biodiesel conversion process, and explore the ability of fungal lipase to convert poor quality waste vegetable oil into biodiesel without soap production. Samples of waste vegetable oil from campus dining halls indicated that approximately three-fourths of the oil would be relatively easy to convert to biodiesel due to low free fatty acid content. Gas chromatography results indicated that greater than 99% biodiesel yield was achieved when using traditional method to convert ISU's waste vegetable oil with low free fatty acid content. Horsepower produced by biodiesel made from waste vegetable oil is comparable to that from petroleum diesel.

About 25% of the waste vegetable oil had free fatty acid content high enough to make biodiesel conversion difficult. The ability to reduce or eliminate high free fatty acid oil would significantly enhance ISU's ability to use its waste vegetable oil as a biodiesel feedstock. When using a whole-cell biocatalyst prepared from the fungus Rhizopus oryzae to catalyze biodiesel production, biodiesel yield was about 75% for virgin oil, 80% for waste vegetable oil and 55% for trap grease. By extending the reaction and use of ethanol, yield was improved to about 90%. These results suggest that whole-cell biocatalyst can effectively catalyze the conversion of virgin canola oil, waste vegetable oil, and even trap grease into biodiesel. Though yields must be increased and costs reduced before the process could become commercially viable, the use of whole-cell biocatalysts holds promise as a method for converting low quality waste grease into a substitute diesel fuel.

ISU Internal Program

Robert L. Rhykerd – Agriculture

Guang Jin – Environmental Health

Illinois State University

From Research to Marketable Wheat By-Product Composites: Phase II

This research explored the potential of developing value-added products from wheat straw and also examined whether a combination of straw with other fibrous materials, such as kenaf and *Miscanthus*, could result in products with superior mechanical characteristics. In particular, researchers attempted to develop three distinct products: novel paperless wallboard materials; high-strength, water-resistant structural materials; and ultra-small straw particle insulation particleboards.

Three important parameters gauge the feasibility of developing value-added products from fibrous materials: strength of the material consistent with the intended use, materials' durability, and whether the products can be mass produced. The following summarizes the outcomes of this research:

Novel paperless wallboard: Previous results have suggested that it may be feasible to develop paperless wallboard materials from micronized wheat straw, straw fibers, and hydrated calcium sulfate. In pursuit of making full-size sheets, a number of fiber materials for the paperless wallboard were explored, including crop and synthetic fibers. Some crops fibers which showed great promise for smaller-sized 2 ft x 4 ft sheets did not perform as well as when the sheet size was increased to 4 ft x 8 ft. However, the cloth woven from wheat straw gave strength and modulus to the product, which was comparable to when glass fibers were used. This straw-cloth fiber also inhibited brittle failure of the paperless wallboard in the flexural mode. A mix was developed, in which a natural protein was used, for the paperless product to be mounted using conventional drywall screws.

High-strength, water-resistant structural materials and ultra-small straw particle insulation particleboards: In an effort to harness the natural polymers present in renewable agricultural byproducts for the development of structural biocomposites, researchers examined how co-processing wheat straw and core kenaf fibers would affect the thermal and mechanical properties of the formulated materials. Results indicated that they are remarkably similar, thus they could be co-processed. The strength of the composites, developed from straw and kenaf, compared favorably with commercial particle boards tested. It was successfully demonstrated that fibrous and natural polymeric properties of crops like straw and kenaf could be used to develop structural composites (70 MPa strength), which have no external polymer additives.

SIUC Internal Program

Vivak M. Malhotra – Physics

Southern Illinois University Carbondale

Alternative Vegetable Crops: Developing Production Practices and Marketing

This project was designed to develop cultural methods and marketing techniques for alternative vegetable crops in southern Illinois to improve sustainability of farming and economic success in local markets. Several specialty vegetables are great crops for sustainable vegetable production systems, as they have few pest and disease problems, including cilantro, garlic, globe artichoke, and sweet potato. These crops require few off-farm inputs such as insecticides, fungicides, or fertilizers, which make them attractive for small local market growers since they have high potential for increasing grower income.

Optimal field cultural practices were determined for various alternative sustainable vegetable crops. Research indicated that the best planting dates for the cilantro cultivars evaluated were from early August to mid-September, although sufficient moisture must be provided to achieve optimal germination rates. If planting is done after mid-September, cilantro goes into the over-wintering phase before marketable leaves are produced; however, late planted cilantro will over-winter in southern Illinois if some type of organic mulch (e.g. wheat straw) is placed around the plant base.

Both 'Emerald' and 'Northern Star' globe artichokes are hardy perennials and will over-winter in southern Illinois if protected during the winter months with an organic mulch and/or a heavy row cover. A perennial globe artichoke planting will remain productive in southern Illinois for about three growing seasons. For garlic, 'Idaho Silverskin' and 'Persian Star' had excellent over-wintering ability, quality bulbs and high yields in southern Illinois. Garlic planted on black plastic provided larger bulbs and better over-wintering survival compared to bare

soil. 'Beauregard' was the best sweet potato cultivar of those evaluated for the southern Illinois climate; but, to maintain high root yields and quality, the seed stock should be replaced every 2 to 3 years.

Based on surveys, consumers are most concerned about quality and appearance of specialty vegetables (51%), followed by price (21%), locally grown (20%), and nutritional value (8%). Results also indicated that consumers have preferences for certain specialty vegetables. Those most likely to be purchased included red heirloom tomatoes, sweet potatoes, garlic, specialty lettuces, personal-sized watermelons, specialty winter acorn squash, and colored bell peppers.

SIUC Internal Program

S. Alan Walters, Bradley H. Taylor – Plant, Soil and Agricultural Systems

Wanki Moon – Agribusiness Economics

Southern Illinois University Carbondale

Sweet and Hot Pepper Production Using Vermicompost and Compost

There is great interest among consumers concerning the quality and safety of their food. More consumers are opting for vegetables grown organically which can cause some concerns for growers about applying enough nutrients when using composted wastes. To investigate

this concern and the resulting yields, a preliminary study was conducted during summer 2005 using traditional compost and vermicompost soil amendments. The use of vermicompost or traditional compost resulted greater early yields when compared to the controls or inorganic fertilizer. Late season yields were not determined. While the results of early yields indicated a positive influence of vermicompost and traditional compost, complete season data is required to fully elucidate the potential benefits for illinois' fresh market growers and ultimately illinois consumers.

In this study, four varieties of specialty bell and one hot pepper were transplanted to small field-grown plots amended with compost (10 t/ha), vermicompost (5 t/ha), compost + 2 lb NPK (nitrogen per 1000 ft^2), and vermicompost + 2 lb NPK. An inorganic fertilizer control (2 lb NPK) and a non-fertilized control were included. Data collected included weekly harvest weight and fruit number. The pepper varieties all responded with greater yields when compared to the untreated control. The average yield increases over the control were as follows: vermicompost, 23%; compost, 11%; vermicompost + NPK, 11%; compost + NPK, 8%; and NPK, 8%. Of greatest interest was the vermicompost treated varieties outperforming all other treatments, even the NPK fortified vermicompost treatment. It has long been assumed that direct comparisons of yield data between yields from organic and inorganic nutrient sources were not completely valid if the nutrients, particularly nitrogen, were not balanced. This study suggests that the addition of inorganic NPK inhibited the positive plant growth influences of the vermicompost. More research is needed to more fully understand the interactions between using composts and inorganic nutrient sources on subsequent plant growth.

ISU Internal Program

Gary R. Bachman – Agriculture

Illinois State University

Utilizing Processed Swine Manure as a Soil Amendment for Crop Production

This study investigates the use of processed swine manure and composted livestock and urban landscape waste as a soil amendment for row crop production. Regulations regarding field application of liquid swine manure are becoming more stringent. Procedures which decrease the nutrient content of manure must be identified and evaluated to protect the soil environment from over-application.

Six soil treatments were evaluated in this experiment: processed liquid swine effluent, raw liquid swine manure, inorganic fertilizer, two rates of compost made from separated solids of liquid swine manure, and zero rate control. For soybean, the six treatments responded in a similar fashion. Since soybean can acquire nitrogen from the atmosphere, this result was expected. In general, the zero rate control plot was the least productive treatment for corn, in contrast to the other treatments. Grain yield of plants supplied with separated liquid swine effluent or manure was the greatest. The two compost treatments and the inorganic fertilizer treatment tended to be somewhat lower yielding. After four years of annual treatment application, the processed liquid swine effluent and raw liquid swine manure treatments were similar for most soil parameters. The separated solid compost typically contained the greatest elemental concentrations of most measured soil parameters. Soil data collected thus far suggests that separated effluent can serve as satisfactory nitrogen replacement for inorganic fertilizer.

This research project provides many benefits for the environment. Composting provides a product that is useful for agriculture and urban uses such as gardening or landscaping. Likewise, the liquid-solid separation of swine waste has benefits for the environment. Ideally, one wants to partition as many of the nutrients in the solid compost as possible. The solid fraction, along with the nutrients that it contains, can be spread on distant fields less expensively than hauling diluted manure. It is hoped the liquid effluent can be applied to soils without a corresponding large buildup in soil nutrient level like phosphorus. The ultimate goal of this research is to improve manure management, which will benefit the livestock producer, and to produce an environmentally-friendly, value-added product that can be marketed wholesale or retail for various soil improvement needs.

ISU Internal Program

Kenneth D. Smiciklas – Agriculture

Illinois State University

Economic Impact of Alternative Organic Weed Control Techniques

The economic efficiency of various organic weed control techniques used on Western Illinois University's Allison Organic Farm was examined. Economic considerations include inputs from commercial and non-commercial organic and pesticide-free sources. Field sizes for treatments used in this study ranged from 5 to 20 acres. Analyses include the cost of labor, tillage, fertilizers, and all organic weed control techniques used on Western Illinois University's Allison Organic Farm was examined. Economic considerations include inputs from commercial and non-commercial organic and pesticide-free sources. Field sizes for treatments used in this study ranged from 5 to 20 acres. Analyses include the cost of labor, tillage, fertilizers, and all operations used in organic systems. Companion fields are farmed using the same methods as the organic fields with the exception that they are fertilized with conventional fertilizers to determine if the organic fertility methods are causing yield loss. The bases of the economic analyses are the returns generated from crop sales minus the costs of production operations as determined using the Iowa Farm Custom Rate Survey.

Land costs are not included in these analyses. While the conventional corn prices from several years ago, which were used in this study, may seem low compared to today's ethanol stimulated corn prices, one has to consider that the present government subsidies for corn based ethanol may not continue indefinitely.

Research results are significantly different from the net returns recorded from the 1998-2000 growing seasons. The table below contains the economic data from the 2006 growing season and presents the data from several fields on the farm. Many changes have occurred since the late 1990s. The National Organic Program in the early 2000s established widely accepted national organic standards. Consequently, demand for organic foods has escalated dramatically. Producers now have organic contracts for soybeans, corn, and soft red winter wheat. Winter wheat provides the environment for establishing red clover by frost seeding in the early spring. The red clover comes on strong after wheat harvest to fix nitrogen and build soil structure. Soybean income was slightly higher in 2006 than in 1999, because the seed for planting was provided by the elevator offering the contract. In the late 1990s, organic soybeans were the only crop on which producers could make a good profit. With the increased offerings for organic corn and organic wheat contracts, average annual income for 2006 was $369/acre for the Allison Farm. This represents an increase of $206/acre, or an increase of 126% over the income/acre received during the 1998 -2000 period.

Gerald T. Vigue – Agriculture
Western Illinois University

Costs and returns for organic corn, soybeans, and soft red winter wheat for the 2006 growing season at the Allison Farm (crops were sold for organic premiums, fields were prepared by conventional tillage)

	Organic Corn	Organic Soybeans	Organic Soft Red Winter Wheat
Price (dollars/acre)	$4.50	$13.58	$6.30
Yield (bushel/acre)	131	34	66
Government payment (dollars/acre)	$32	$32	$32
Total revenue (dollars/acre)	$622	$494	$448
Total costs (dollars/acre)	$218	$148	$90
Net income	$404	$346	$358

Average annual income/acre: $369

Livestock

Testing and On-Farm Application of Odor Reduction Technologies for Swine Facilities

Emissions of dust, odors, and gases from swine facilities continue to be major issues with the general public that limits the future development of the Illinois swine industry. Developing practical, cost-effective approaches to reducing or, ideally, eliminating emissions would be a major step towards addressing public concerns relating to proposed sitings of new swine facilities and expansion of existing operations.

The Good Neighbor System (GNS) is a commercially available program that is being used by the industry which is reported to be highly effective in reducing emissions from swine facilities. The GNS is a fully-automated system that consists of three processes, as follows: (1) treatment of the stored manure with a neutralizing agent to increase the pH of the slurry to reduce the release of hydrogen sulfide and volatile fatty acids, (2) covering the surface of the manure in the pit with a liquid oil "lid" to reduce gaseous emissions, and (3) spraying the building air space with an atomized oil-based liquid acidifier to reduce ammonia and dust levels within the building.

The overall goal of this study was to investigate the effectiveness of the GNS at reducing gaseous emissions from swine facilities under full-scale production conditions. Also, the impacts of the GNS on manure composition and animal performance and on the costs associated with adopting the system on typical swine facilities were evaluated.

The evaluation of the GNS was carried out in four identical commercial wean-to-finish barns with two barns being treated with the full GNS program and two barns left untreated as the controls. Monitoring of the barns was carried out over a 12-month period to test the GNS in the range of weather conditions typically experienced in the Midwest of the U.S. Data collection and analysis is still in progress and only preliminary results are reported.

Treating the barns with the GNS compared to the untreated control barns reduced ammonia emission rates (by ~15%) and odor concentrations in the exhaust air stream (by ~33%), however, hydrogen sulfide emission rates were actually higher for GNS barns compared to the controls. There were no practically important differences in the growth performance and health status of the pigs between the GNS-treated and control barns. Also, the composition of the manure was similar for the barns with and without the GNS. Costs associated with the purchase and installation of the GNS for a typical 1,000 head wean-to-finish barn were approximately $14 per pig place and material costs (for the liquid oil lid, atomization solution, and pit neutralizer solution) equated to around $3.50/pig produced. Assuming the 10 year depreciation time claimed by the supplier for this system resulted in a total cost for installing and operating the system of approximately $4.19/pig produced.

The results of this study suggest that the GNS was effective at reducing odor and ammonia emissions from typical swine facilities. There was no positive impact of the GNS on manure nutrient composition or animal performance and, consequently, no economic gains to offset against the cost of adopting this system.

External Competitive Grants Program

Michael Ellis – Animal Sciences

Ted L. Funk, Yuanhui H. Zhang – Agricultural and Biological Engineering

University of Illinois at Urbana-Champaign

Evaluation of a Swine Manure Management System to Control Odor and Reduce Non-Point Source Pollution

The purpose of this ongoing research is to (1) evaluate a production scale of on-farm demonstration and technology transfer initiative to encourage farmers to adopt innovative waste management and odor reduction technologies for liquid swine manure; (2) analyze the combination of solid/liquid separation of liquid manure with solids composting to control odor and reduce phosphorus contamination; and (3) develop educational materials and offer workshop/field days designed to inform farmers and educators about improved adaptive management practices for handling swine slurry that can reduce non-point source pollution.

A solid-liquid separation system has been developed by modifying existing technology that can effectively separate liquid swine manure into its solid and liquid phases. A traditional polymer assisted gravity belt thickener has been combined in tandem with a gravity screen separator to process raw swine slurry. This system has processed over one million gallons of raw slurry for each of the past two years producing over 1.8 million gallons of separated effluent and 200,000 gallons of biosolids containing 10-12% dry matter. This system has continuously removed from slurry 98% of the separable solids, 98% of the total suspended solids, 89% of chemical oxygen demand, 60% of the nitrogen, 92% of the phosphorous and has changed

the nitrogen to phosphorus ratio from 4:1 in unprocessed slurry to 15–20:1 in separated effluent. The cost for composting the biosolids fraction ranges from $10 per ton to $20 per ton of finished compost. The cost to produce the separated effluent has been 0.99¢ per gallon (0.90¢ per gallon of raw slurry processed).

This research has yielded a separated effluent that can serve as a source of nitrogen for corn production without concern that phosphorous may be oversupplied. Antidotal observation has found reduced odor and fly populations within the swine buildings supplying raw slurry for separation wherein the pits are drained weekly and recharged with separated effluent.

ISU Internal Program

Paul M. Walker – Agriculture

Timothy R. Kelley – Health Sciences
Illinois State University

Duane E. Friend – University of Illinois Extension

Evaluation of Land Application Systems for Swine Manure to Reduce Non-point Source Pollution

Researchers have developed a successful manure treatment system that couples polymer-assisted separation of liquid manure with composting. This solid-liquid separation of raw swine manure makes it possible to reuse the solid fraction with a high carbon and phosphorus content separately from the liquid fraction with a high nitrogen content.

Separation consistently removes more than 90% of the solids and approximately 90% of phosphorus from liquid manure. The solids fraction is composted, producing a value-added coproduct that can be sold off-farm or transported longer distances for cropland application. The separated effluent is stored in holding tanks for subsequent land application. This direct utilization of the liquid fraction is advantageous because it is simple, has a low application cost, and allows for direct use of nitrogen. Most importantly, this adaptive management technology changes the nitrogen:phosphorous (N:P) ratio in unprocessed slurry from 4:1 to 15–20:1 in the separated effluent. A N:P ratio of 12–15:1 is reflective of the N:P ratio required by most plants during the growing season, especially by corn, thereby minimizing environmental concerns regarding phosphorous contamination.

Currently, it costs swine producers between 0.70¢ per gallon and 1.7¢ per gallon of raw, unprocessed slurry to land apply liquid manure when using soil injection equipment. Every mile slurry must be hauled prior to land application adds 1.0¢ per gallon to the cost. Irrigation of raw slurry costs 0.1¢ per gallon and is the most cost effective method of land application. However, the odor generated by unprocessed slurry during irrigation and the potential for runoff pollution prevents irrigation of unprocessed slurry from being widely used in Illinois. Separation of raw slurry costs 0.90¢ per gallon. Combining separation and irrigation suggests that separated effluent could be land applied for 1.0¢ per gallon, similar in cost to current injection methods for unprocessed slurry. However, the dynamics of nutrient movement in soil and in ground water with surface irrigation has not been well documented. The purpose of this project is to (1) compare raw slurry, separated effluent, composted biosolids, and inorganic fertilizer as soil amendments for corn and soybean production; (2) evaluate center-pivot irrigation as a mechanism for land application of separated effluent; and (3) evaluate nutrient/pathogen transfer from raw slurry, separated effluent, composted biosolids, and inorganic fertilizer to crop seed, to soil, and to ground water.

Four 40-acre fields are being utilized in this multiyear study. Unprocessed slurry via injection, separated effluent via center-pivot irrigation, composted biosolids (separated swine manure solids) via broadcast followed by incorporation, and inorganic fertilizer via injection and broadcast incorporation are being land applied to provide 180 pounds of nitrogen per acre. Data collected thus far have provided the following observations: Numbers of indicator pathogens (E. coli and other fecal coliforms) detected in unprocessed slurry have been decreased by separation in separated effluent. No transfer of indicator pathogens has been detected in corn grain or soybeans, and similar corn and soybean yields have been obtained when grown on soils amended with unprocessed slurry, separated effluent, composted biosolids, or inorganic fertilizer. Raw slurry has resulted in the lowest fertilizer cost per bushel of yield compared to the other three soil amendments. Application of separated effluent has resulted in negative phosphorous balance. Injection of raw slurry has resulted in the greatest over application of and buildup of soil phosphorous. Center-pivot irrigation of separated effluent has resulted in negligible odor generation during land application.

ISU Internal Program

Paul M. Walker, Kenneth D. Smiciklas, Robert L. Rhykerd – Agriculture

Timothy R. Kelley – Health Sciences
Illinois State University

Duane E. Friend – University of Illinois Extension

Walt R. Kelly – Illinois State Water Survey

Performance of Finishing Pigs in Hoop and Confinement Housing During Winter and Summer in a Southern Environment

Modern swine production houses pigs in confinement buildings focusing on increasing pig performance and improving economic return by increasing the number of pigs produced per square foot and reducing labor costs. While the impact

of current production processes have improved the efficiency of swine production, the impression left from these large confinement-style operations with the general public leaves a lot to be desired. With all the gains made by implementation of modern production facilities, the important social concept of holistic, sustainable livestock production has been overlooked. For this reason and others, there has been renewed interest in low-cost, sustainable production units. The goal of this study was to evaluate the efficacy of using a hoop structure for growing-finishing pigs in southern Illinois.

Housing pigs in hoop structures in southern Illinois tended to increase average daily gains over pigs housed in conventional naturally ventilated barn. This effect may be due to the relatively poor environmental control available in the conventional, naturally ventilated barn used in this study. Average daily feed intake was not affected by housing type, however season significantly affected feed intake with the highest intake occurring during the spring, and the lowest during summer. Feed efficiency did not differ among the housing types during this study. Similar studies conducted in northern environments reported pigs finished in hoop structures during the summer had improved average daily gains and similar average daily feed intake and gain per feed ratios. However, this study suggests that pigs raised in hoop structures in a southern environment react differently than pigs raised in a northern environment. Summer numerically reduced average daily gains, but performance was numerically greater for hoop housed pigs during spring and fall. These results have shown that raising pigs in a hoop structure in southern Illinois is effective and does not slow pig performance as compared with performance in a naturally ventilated facility, and given the lower capital investment, may be an efficacious alternative to raising confined pigs in southern Illinois.

SIUC Internal Program

Gary A. Apgar – Animal Science, Food and Nutrition

Dwight R. Sanders – Agribusiness Economics

Southern Illinois University Carbondale

Evaluating Short Season Field Peas as an Economically Viable and Nutritionally Appropriate Diet for Nursery Pigs

The main objective of this study was to determine if yellow, short-season field peas could partially replace corn and soybean meal in the mid- and late-nursery pig diets, and to evaluate the efficacy of a fungal hemicellulase/cellulase preparation containing alpha-galactosidase, galactomannanase, xylanase, and beta-glucanase (enzyme) in nursery pig diets with and without field peas.

Two trials were conducted where all pigs were fed a two phase program (P1and P2) provided for 14 days each. The combination enzyme was supplemented at the rate of 0.1% and 0.05% for P1and P2. In trial 1, researchers observed significant increases in average daily gain, 385 vs. 418 g/day for control and peas, respectively; average daily feed intake, 561 vs. 632 g/day for control and peas, respectively; and decreases in gain to feed ratio, 685 g/kg vs. 658 g/kg for control and peas from 0-28 days. Pigs in trial 1 fed diets containing field peas combined with enzyme supplementation tended to increase average daily gain from 0-28 days and feed intake from 21-28 days. Additionally, trial 2 pigs fed diets containing enzyme significantly increased average daily feed intake from 14-21 days. Inclusion of yellow field peas (20%) in the mid- and late-nursery periods provided significant improvements in nursery pig growth performance compared to corn-soybean meal based diets. Supplementation of exogenous carbohydrase enzymes tended to improve nursery pig performance when diets contained 20% field peas.

ISU Internal Program

Bryon R. Wiegand – Agriculture

Illinois State University (currently at University of Missouri)

Evaluating Short-season Field Peas Processed with Two Milling Types to Improve Growth and Performance in Nursery and Grower Pigs

Previous work has shown that yellow, short season field peas are nutritionally adequate feedstuffs for nursery, growing, and finishing pigs. However, literature reports indicate that particle size of field peas influences pig performance. Little information is available regarding the milling and particle size characteristics of this alternative feedstuff. The objective of this study was to evaluate the milling characteristics of field peas using two mill types. Peas grown in South Dakota were obtained and the seeds cleaned of foreign matter. Peas were compared with number two yellow corn in six replications of each subjected to hammer (H) and roller (R) milling applications.

Grains were milled and samples were collected for moisture and particle size determination through a USA sieve system using a RoTap agitator. Least squares means were calculated for corn and pea samples collected from six sieve diameters (300 to 1000 microns). Mean particle size was calculated and standard deviation of particle size was determined. Corn and pea samples did not differ for moisture percentage at time of milling. Statistical analysis resulted in a grain × milling type interaction. R corn had the greatest sample weight screened by the 1000 micron sieve (107 g). Similar interactions were observed for R peas with 850 and 710 micron sieves producing 27.45 g and 27.16 g of sample weight, respectively. At the smallest sieve size (300 micron), H milling produced more total sample weight regardless of grain type with 19.24 g vs. 10.70 g for H and R milling,

respectively. Feed particles of this size can be detrimental to pig growth performance. Mean particle size differed for H corn (575 micron±1.38) and R corn (619 micron±1.37), H peas (616 micron±1.37), and R peas (658 micron±1.34). R corn and H peas were not different, but each differed from R peas for mean particle size.

ISU Internal Program

Bryon R. Wiegand – Agriculture

Illinois State University (currently at University of Missouri)

Evaluation of Offal Composting as an Alternative to Rendering

Composting should provide an inexpensive alternative to animal rendering pickup services for the disposal of butcher wastes and other biological residuals. The temperatures achieved during composting should kill or greatly reduce most pathogens, reducing the chance to spread disease. Composting and sanitation are not necessarily synonymous. For sanitization to occur, certain conditions must be supplied during the compositing process. These conditions are fairly well known for more traditional composting scenarios (livestock manure, landscape waste, etc.). These parameters, however, have not been well established for offal composting. Materials other than butcher waste, when properly composted, have been found environmentally safe and a valuable soil amendment for growing crops. These facts have not been determined or demonstrated for compost derived from offal. The purpose of this project is to evaluate the potential for pathogen transfer from carcasses to the environment during composting, to evaluate the economic feasibility of composting offal, and to develop recommendations for regulatory agencies regarding policies affecting proper composting of offal.

Illinois EPA and local siting approval were obtained for an offal composting facility located near Forrest, Illinois. Rapid composting of animal carcasses and parts requires grinding or chunking of the animal tissue. Offal composting, including blood, can be successfully composted with minimal odor if an appropriate carbon to nitrogen ratio is maintained. Best management practices require a two-stage composting process. Stage one should occur within an enclosed building, ventilated through a biological filter. Stage one may be as short as six weeks. Stage one may be either an anaerobic or aerobic process. Stage two can occur within a building or outdoors. Composting occurs more rapidly if stage two is an aerobic process with compost turned once or twice weekly until fresh compost status is achieved. Composting can eliminate pathogen *(E. coli and Salmonella)* activity. Composting of offal can reduce disposal costs and produce a sanitized compost suitable for use as a soil amendment.

External Competitive Grants Program

Paul M. Walker – Agriculture

Timothy R. Kelley – Health Sciences

Illinois State University

Duane E. Friend – University of Ilinois Extension

Building Illinois Meat Supply Chains: Analyzing Processors and Meat Managers

This project focuses on the development of economically viable high-quality supply chains for value-added livestock products. The overall goal is to give producers greater access to markets currently being served by commodity supply chains.

Illinois meat processors were surveyed to develop a profile of meat processors most likely to participate in a quality-driven supply chain and to determine their perceived educational needs. This data shows a significant need for training and education for small- to mid-sized meat processors focused on marketing, food safety, governmental regulations, and technology. Approximately 85% of consumers are concerned about "where their food comes from." Researchers have collaborated with the Illinois Association of Meat Processors to focus on how local meat processors can benefit from the interest in local and regional food systems. Small- and mid-sized meat processors working with livestock producers can be the ultimate local food providers.

Collaboration with the Illinois Food Retailers Association has resulted in completion of food retailer focus

groups, individual interviews, and store audits, followed by personnel training and a written survey. The findings of this study indicate that meat department managers recognize the need for personnel training, and that training can have an impact on in-store shrink. Concerning working directly with livestock producers, meat department managers have a relationship with their distributors, and regardless of the nature of this relationship, they are reluctant to risk loosing the present supplier. Consequently, researchers are currently working with the Illinois Beef Association to survey meat distributors to determine their level of interest in working with livestock producers to develop pull-demand for differentiated meat products.

The MarketMaker website was created to build an electronic infrastructure connecting farmers with economically viable new markets, to aid in the development of quality-driven food supply chains, and to give Illinois farmers greater access to regional markets by linking them to all other food supply chain participants. Taking the single state concept and expanding it into a regional/ national model has significantly grown the economic impact of this marketing resource. A 20-state partnership of land grant institutions and state agricultural agencies has formed to build the National MarketMaker Network. It is the most extensive collection of searchable food industry–related data in the country, containing over 250,000 profiles of farmers and other food-related enterprises. All the information can be mapped and queried by the user.

External Competitive Grants Program

Darlene S. Knipe, Richard K. Knipe, M. Patrick Curry – University of Illinois Extension

Alan J. Miller, Floyd K. McKeith, Tom R. Carr – Animal Sciences

Peter D. Goldsmith – Agricultural and Consumer Economics

University of Illinois at Urbana-Champaign

Foods

High-Quality Protein Enhances Diet Control of Type 2 Diabetes

The goal of this research was to demonstrate that diets with increased high-quality protein and reduced levels of high-glycemic carbohydrates would contribute to enhanced regulation of blood glucose and insulin when compared with more traditional diets such as MyPyramid, which recommends high carbohydrates and low protein intakes. This research featured a new animal protocol developed as a model to study prediabetes conditions, which allows researchers to investigate and understand molecular aspects of glucose regulation. A small clinical study with type 2 diabetes subjects was also conducted to test the diet concepts in a human population with abnormal glucose regulation. The research evaluated key regulatory steps of glucose metabolism, including liver control of glucose production and mechanisms for insulin action in skeletal muscle and fat tissue.

The animal research provided evidence that the diet with increased protein and reduced carbohydrates (PRO diet) produced significant changes in glycemic regulations (i.e., insulin actions and glucose handling) compared with the more standard recommendation for a high-carbohydrate, low-protein diet (CARB diet). This research showed that the PRO diet increased insulin sensitivity in skeletal muscle, enhanced regulation of blood glucose, and increased muscle protein synthesis. The PRO diet also served to minimize insulin potential to direct blood glucose to storage as body fat. These molecular findings agree with results from human weight-loss studies that demonstrate that the PRO diet serves to stabilize blood insulin and glucose and improves body composition by reducing fat and maintaining muscle. These outcomes demonstrate that diet changes within the Dietary Reference Intakes (DRI) guidelines produce significant differences in regulation of blood glucose.

The diabetes study provided a test of diet concepts under the extreme conditions of preexisting abnormal glucose and insulin metabolism. Subjects were recruited as adults newly diagnosed with type 2 diabetes and not treated with previous diets or medications. The hypothesis was that the PRO diet would stabilize blood sugar and help subjects lose weight. After only three weeks following the PRO diet, 8 out of 9 subjects stabilized blood glucose at normal levels that were no longer diabetic. After four weeks, blood glucose and insulin and blood lipids (cholesterol, LDL, HDL and triglycerides) were all within normal ranges, and after 10 weeks subjects had lost an average of 14 pounds of body weight with 80% of the weight loss derived from body fat. This small clinical study provides evidence that the PRO diet can improve carbohydrate metabolism and suggests that many adults may be healthier with carbohydrate intakes that are at the lower end of the DRI guidelines.

External Competitive Grants Program

Donald K. Layman – Food Science and Human Nutrition

Ellen M. Evans – Kinesiology

University of Illinois at Urbana-Champaign

Characterizing the Protective Effects of Soy Oil on Risk Markers for Cardiovascular Diseases

Soy oil is rich in polyunsaturated fatty acids such as linoleic and linolenic acids. The overall goal of this research was to investigate the cardiovascular health benefits of soy oil. Specific objectives were (1) to demonstrate that the oil component of soy exerts cardiovascular health benefit by lowering the markers for cardiovascular disease risk, and (2) to test the relative cardiovascular disease benefit of the low-linoleic soy oil compared to non-soy oil sources.

Soy has multiple components: proteins, fiber, fatty acids, and bioactive compounds such as isoflavones. The first priority was to demonstrate the health impact of soy with and without the oil component so the health impact of each component could be isolated. Researchers conducted studies that isolate effects of soy lipids by feeding fat-free soy and intact or full-fat soy protein. Results showed that relative to casein, the control protein source, both fat-free and full-fat soy significantly lower cholesterol in rats. In addition, the full-fat soy appears slightly better than the fat-free soy in lowering cholesterol. Therefore, researchers conclude that soy protein has cardiovascular benefit by lowering cholesterol, and the presence of the lipid component in soy appears to have additive cardiovascular benefit.

SIUC Internal Program

Kolapo M. Ajuwon, D. Allan Higginbotham, William J. Banz – Animal Science, Food and Nutrition

Southern Illinois University Carbondale

New Product Development and Supply Chain Management of U.S. Confectionery Manufacturers

The U.S. confectionery industry, with $28.9 billion retail sales in 2006, has been the number one sector of the food industry in terms of numbers of new product introductions. The purpose of this project was to gather and share information on this highly valued industry with the interested parties, including confectionery manufacturers, trade associations, and other researchers.

Researchers surveyed manufacturers and asked them to provide information on their most recently introduced new product. Information on 92 new products was received. On average, manufacturers who responded to the survey have been in business for 48 years. These manufacturers expected 11.4 percent of their sales in year 2006 to come from new products introduced in 2005. Survey respondents reported that the most emphasized type of product was chocolate candy, which was followed by non-chocolate candy and snacks. Representative manufacturers ranged from very small to very large, both in terms of annual sales and number of employees. The majority of manufacturers fell into annual sales of less than $5 million dollars, with 18% of manufacturers grossing over $100 million dollars. Fifty-five percent of the responding manufacturers indicated that, on average, less than 2% of revenue from annual sales was spent on new product development process. There were only two manufacturers who spent more than 20% of their sales on new product development expenditures.

Responding manufacturers reported a total of 877 new product introductions in 2005. The majority of these introductions were modifications, followed by new items and new product lines. The most commonly reported new attribute of the products was taste, followed by health, convenience, and nutrition. In the development of new products, the most common source for product ideas was market trends, followed by customer requests, upper management, and employees. The confectionery manufacturers spent 9.5 months on average to develop a new product. The most time was spent on product development and concept search stages, and the least time was spent on product use, field and test marketing, and concept screening stages.

ISU Internal Program

Aslihan D. Spaulding – Agriculture

Illinois State University

Agricultural Studies

Determining the Market Potential of Organic Food Production

This research focused on evaluating the current production and marketing approaches of Illinois organic producers, determining the market potential for organic products in Illinois, and making the results available to farmers. Researchers identified perennial weed management as a major limitation. The second portion of the research developed management strategies for perennial weeds.

Large demand for organic products exists in Chicago, the Quad Cities, and downstate. Illinois has 152 certified organic farmers. Surveying 150 Illinois organic farmers showed they are growing primarily corn and soybeans to meet demand for ingredients for processed organic foods and organic feeds. There was interest in growing other crop mixes and in value-added processing. Interviews with retailers, restaurants, and cooperatives in Chicago revealed that 95 percent of organic produce is sold through large supermarkets in Chicago, accounting for over $60 million in revenue, but that only 3% of this organic produce is grown locally.

Existing marketing venues for direct marketing include community-supported agriculture, farmers' markets, on-farm sales, and selling to restaurants. Marketing challenges facing organic farmers include finding markets and buyers, fluctuating demand, lack of public awareness, farmland, training, philanthropic funds, and the need for a transportation and distribution infrastructure.

Researchers found that tillage, Sudan grass, and mowing can be combined to suppress perennial weeds. Sudan grass alone, or combined with mowing, controlled patches infested with Canada thistle through the second growing season. Several organic farmers have adopted this system. This project also allowed researchers to receive additional funding to expand research on sustainable approaches to perennial weed management.

Researchers have developed tools to assist current organic farmers and those interested in transitioning into organic production. This information includes how to become certified, research results, organic marketing, and organic weed control. The information is available on the Agro-ecology and Sustainable Agriculture Program website (http://asap.sustainability.uiuc.edu/).

External Competitive Grants Program

John B. Masiunas – Natural Resources and Environmental Sciences

University of Illinois at Urbana-Champaign

Increasing Landowner Income through Recreational Leases

The purpose of this study was to provide information to landowners and professional farm managers about the recreational lease market in Illinois, in order to enhance their income and land use decisions. The specific objectives were: (1) to determine the extent of recreational leasing activity among Illinois Professional Farm Managers; (2) to determine the lease terms and rents for recreational leases in Illinois; (3) to determine the land management practices, land characteristics, and other factors that affect recreational lease rates; and (4) to identify factors that deter landowners from offering recreational leases, and problems encountered by those with recreational leases.

Fifty-two farm managers out of 133 Accredited Farm Managers belonging to the Illinois Society of Professional Farm Managers and Rural Appraisers (ISPFMRA) completed a recreational leasing survey. The respondents managed a total of 585,000 acres, of which 18,300 acres were under recreational leases. Twenty farm managers had clients with recreational leases.

Analysis of the data from the survey provides the following results:

- Thirty-eight percent (38%) of the managers had property with recreational leases. For managers without recreational leases, 35% indicated they would likely have recreational leases in the next 5 years. This would add 12,500 acres with recreational leases, assuming managers maintained 6% of their managed land in recreational leases.
- Lease rates ranged from $1 to $75 per acre. Average lease rates were $8 per acre for median-quality recreational property and $31 per acre for high-quality recreational property.
- Location, land mix, and adoption of land management practices to enhance habitat had a positive impact on lease rates. High-valued recreational property located in region 4 (Western Illinois) added $15 per acre to lease rates. Land management practices to enhance habitat increased lease rates by $20 per acre. For median-valued property, 100% wood over 0% woods increased lease rates by $12 per acre.
- Trespassing or poaching, boundary disputes, and farm tenant conflicts were the highest-rated problems.

Researchers conclude that opportunities for recreational leasing provide a means to increase landowner income and enhance wildlife habitat.

SIUC Internal Program

Phillip R. Eberle – Agribusiness Economics

Southern Illinois University Carbondale

Natural Resources

Alternative Nitrogen Fertilization Management for Sustainable Turf Grass Growth

The objective of this research is to evaluate alternative nitrogen sources, both inorganic (quick release and slow release) and organic (vermicompost and steer manure) in sustainable turf management. The primary goal is to reduce mineral fertilizer use while maintaining optimum plant growth.

Fertilizer treatments were applied at the same nitrogen rate for two turf species, yet both similarities and differences were observed resulting from the various sources. For both types of turf, chemical fertilizers provided increases in turf growth and early-season turf quality ratings. Bermuda grass was most responsive to urea for early-season turf quality, whereas tall fescue responded most positively to ESN®. Turf growth was maximized by use of chemical fertilizers, particularly early in the season, but this may not be desirable in turf systems because of the increased turf maintenance associated with increased growth. Increased turf growth attributed to chemical fertilizers continued throughout the season with tall fescue. Nitrogen uptake and total nitrogen content were also greatest with chemical fertilizers in both turf species. This increased uptake likely played a role in the decreased nitrate leaching in tall fescue.

ESN was the most environmentally friendly fertilizer source in regard to nitrate leaching in tall fescue, whereas both chemical fertilizers produced over twice as much nitrogen leached, compared to the organic sources in Bermuda grass. The impact on turf quality combined with the low level of leaching makes ESN the best choice for nitrogen fertilization in tall fescue. There was no significant difference seen between the chemical fertilizers and steer manure for turf quality in Bermuda grass. This, along with the low levels of leaching, make steer manure a good option in the phasing out of, or use in conjunction with, chemical fertilizers in Bermuda grass. The use of steer manure on Bermuda grass in particular should have a positive impact, not only on the environment, but also on turf producers' and golf course superintendents' ability to comply with government regulations to reduce nitrate pollution. There are also possible economic benefits of using steer manure, especially with rising costs of nitrogen fertilizer, depending on its local availability.

SIUC Internal Program

Jorge D. Hernandez, She-Kong Chong, Brian P. Klubek – Plant, Soil and Agricultural Systems

Southern Illinois University Carbondale

Active Research Projects

The following projects were ongoing in 2007. Those projects having received a no-cost extension are marked with an asterisk (*). Requests for no-cost extensions are granted when unforeseen circumstances arise in completing the research.

Research Focus: Expanding Agricultural Markets

Alternative Crops Development
Winthrop B. Phippen, WIU

Establishment of an alternative crops breeding and production program initially aimed at introducing alternative crops, such as cuphea and milkweed, to the Midwest region.

Engineering Yeast Strains to Enhance Bioethanol Production Efficiency
Ahmad M. Fakhoury, SIUC

Due to increased demands for ethanol as a biofuel, there is need to enhance the process by which ethanol is fermented from corn starch. Successful fermentation requires strains of *Saccharomyces cerevisiae* that can tolerate, among other conditions, increasing ethanol concentrations and decreasing pH. While existing strains of this yeast may be adequate for current needs, there is great need to develop improved strains that will generate ethanol more effectively. Specific goals of this project are to (1) generate yeast mutants tolerant to high concentrations of ethanol and low pH; and (2) partially characterize mutations in generated *S. cerevisiae* strains.

Enhanced DDGS from the Elusieve Process: Foodstuff for Nonruminants
Vijay Singh, UIUC

The elusieve process enhances distillers dried grains with solubles (DDGS) by removing fiber and increasing protein and fat contents. Enhanced DDGS will be evaluated as foodstuff for poultry and swine industries.

Enhancing the Nutritional Value of Milk and Milk Products by Boosting their Omega-3 Fatty Acids Content
Amer A. AbuGhazaleh, SIUC

The primary objective of this project is to establish procedures for the on-farm production of omega-3–enriched milk and milk products. The production of omega-3–enriched milk, cheese, and ice cream will be accomplished through supplementing grazing cows with dietary algae, fish oil, and linseed oil. Consumer acceptability of milk, cheese, and ice cream enriched with omega-3 will also be evaluated.

Establishing an Illinois Soy Foods Center for Research and Education*
Barbara P. Klein and Keith R. Cadwallader, UIUC

Create facilities to develop and test healthy new foods from soybean. The Soy Foods Center will also work on marketing and technology transfer. The goal is to greatly increase human consumption of soy.

Fractionation of Thin Stillage from Dry-Grind Processes to Determine Water Recycling Rates and Heat Transfer Properties
Kent D. Rausch, UIUC

Determine membrane filtration and heat transfer fouling characteristics of the thin stillage process stream in an effort to identify opportunities for increasing value of this stream while increasing water recycle and reducing energy requirements during production of ethanol.

Optimizing Food and Fuel Production
Larry L. Berger, UIUC

The effects of plant maturity and chemical treatment on the nutritional value of corn stalklage fed with distillers grains to growing cattle will be determined. Investigators will determine the energy feasibility and process economics for both drying and freezing alternatives in corn preservation. The quality of the fermentations resulting from these two alternatives will be quantified.

Pork: A Potential Omega-3 Food Source in the American Diet
Amer A. AbuGhazaleh, SIUC

The purpose of this project is to enhance the nutritional value and quality of Illinois pork by boosting the concentration of omega-3 fatty acids. The long-term objective of this project is to enable Illinois hog farmers to enter the fastest-growing and -expanding sector of the agricultural market in the United States today (healthy food market) by engaging them in alternative hog production systems through which value-added products are produced.

Thermochemical Conversion (TCC) of Biomass for Renewable BioEnergy
Yuanhui Zhang, UIUC

Establish an integrated, hydrothermal, and biological-based thermochemical conversion technology and process for renewable bioenergy production using agricultural waste. A variety of biomass will be converted to fuel, fuel additives, and value-added chemicals.

Research Focus: Rural Economic Development

Characterizing Virus-Nematode Complexes that Limit Vineyard Sustainability
Bradley H. Taylor, SIUC

Locally grown grapes drive winery production and marketing opportunities. Emergence of chronic debilitating diseases threatens these opportunities. This project will define incidence of virus-nematode complexes in Illinois vineyards, relate it to associated management practices, and develop strategies to preserve the $34 million overall potential impact to our rural economies.

Development of Enterprise Profit Models for the Illinois Livestock Industry
Michael F. Hutjens, UIUC

This project is designed to identify financially profitable opportunities for Illinois producers interested in livestock as a main or alternative enterprise. The objective of this research is to ultimately develop strategic profit models for the swine, dairy, and beef industries.

Engineering-Economic System Models for Rural Ethanol Production Facilities
Luis F. Rodríguez, UIUC

The emergence of the ethanol industry has boosted the rural economy, although small plants are under competitive pressure. Researchers shall build an integrated systems model of the industry to evaluate the sustainability of cooperative dry-grind facilities.

YouthWorks: Youth Leading Rural Communities' Economic Revitalization
Laurie F. Kramer, UIUC

This research builds on current USDA-NRI funded research to promote the further development, evaluation, and dissemination of YouthWorks, a system of interrelated interventions designed for increasing the number of competent young adults in the Illinois agricultural and entrepreneurial systems, and for enhancing local youths' commitment and future contributions to their community.

Research Focus: Agricultural Production Systems

A Novel Method for Disease Control in Livestock: Distillers Dried Grains with Solubles and Other Fibrous Feeds

James E. Pettigrew, UIUC

Evaluate the impact of dietary distillers dried grains with solubles on young pigs experimentally infected with *Escherichia coli* and on young chicks challenged with the coccidial species *Eimeria acervulina*.

Consumer Attitudes and Expectations Toward Farm Animal Welfare*

Aaron S. Moore, ISU

This study will develop and test the use of survey instruments and interview techniques to ascertain how consumers conceptualize farm animal welfare, and identify consumer expectations for welfare-friendly livestock production.

Development and Evaluation of a Value-Added Feedstuff Using Distiller's Grains*

Paul M. Walker, ISU

This study uses extrusion technology to combine wet distiller's grains with either whole soybeans or soybean meal to develop a value-added feed for swine and cattle. It includes digestibility trials and feeding trials with both swine and cattle.

Development and Evaluation of High-Efficiency, Flexible Intelligent Farming Tools: Phase I - Autonomous Weed Control

Tony E. Grift, UIUC

Develop robotic hardware, networking capabilities, and software algorithms necessary for optimal weed management within a variety of conventional and alternative cropping systems.

Effect of Variability in Gestation Stall Micro-Environment on Sow Well-Being, Physiology, and Productivity

Robert V. Knox, UIUC

A research facility will be created with capability for advanced control and measurement systems using sensors that will simulate microenvironment variations in light intensity and thermal zones similar to those found in commercial swine gestation buildings. Physiology, behavior, and reproductive efficiency of the sow will be assessed in this environment.

Impact of Fermented Soybeans on Phosphorous Absorption in Weaned Pigs*

Kerry W. Tudor, ISU

In this study two nursery pig diets will be fed to weaned pigs in a replicated experiment. The control diet will contain standard soybean meal, and the other will contain fermented soybean meal.

Initiative for Low-Input Apple Production in Illinois

Schuyler S. Korban, UIUC

The overall goal of this initiative is to develop a low-input production system for the Illinois apple industry that minimizes pesticide use, coupled with economic and marketing strategies for increasing profit and diversifying income.

Integrated Genomic Biology in Beef Cattle

Dan B. Faulkner, UIUC

Investigators will obtain estimates of genetic parameters for all traits measured, including the unique measurement of individual feed intake, feed efficiency, residual feed efficiency, and tenderness. The relationship between heterosis and breed composition will be studied. Genetic x environment interactions will be assessed, and an evaluation of residual feed efficiency on subsequent performance of heifer calves will be conducted.

Multidisciplinary Research and Discovery Program to Convert Renewable Plant/Crop Biomass into Renewable Fuels and Chemicals
Hans P. Blaschek, UIUC

This research initiative involves a diverse, multidisciplinary group of scientists working together to integrate and focus research on overcoming problems related to the conversion of biomass to renewable fuels and chemicals.

On-Farm Evaluation of Alternatives to Antibiotics in Pig Production
James E. Pettigrew, UIUC

Researchers propose to evaluate various cereal grains and egg products as alternatives to antibiotics in the diets of young pigs on a commercial farm by assessing their effects on growth performance in a series of five experiments.

Pioneering Bionanosensing Systems for Use as a Decision Support Tool for Soybean Disease Management
Linda S. Kull, UIUC

A decision support tool will be developed to assist soybean producers to define if and when to apply fungicides for management of soybean rust.

Soybean Health: Rust Gene Discovery Initiative
Schuyler S. Korban, UIUC

A search for candidate genes associated with soybean rust resistance will be undertaken. High-throughput screening of these candidate genes will be accomplished. The functionality of these genes and their role in rust resistance in soybean plants will be confirmed by developing knock-out mutants using RNAI technology.

The Physiological Impact of Commingling Pigs*
Mark D. Hoge, WIU

This research will assist producers in selecting the most effective way to manage and transport pigs that originate from different pens.

The Sentinel Crop Gene Identification Project
Lila O. Vodkin, UIUC

The goals of this project are to develop, test, and implement new approaches to determine the biological functions for corn and soybean crop-specific genes (CSGs). These approaches will integrate the use of bioinformatics, molecular biology, and genetics to add functional information to genomes and evaluate the potential of CSGs in crop improvement.

Toward Reducing Soybean Yield Losses Caused by Ozone
Brian W. Diers, UIUC

Physiological and molecular tools will be used to identify the most ozone-tolerant soybean germplasm. Tools will be tested by evaluating diverse accessions from the USDA Soybean Germplasm Collection.

Research Focus: Human Nutrition and Food Safety

Adipotoxicity Biomarker Discovery Using a Canine Diet-Induced Obesity Model

Kelly S. Swanson, UIUC

Investigators will identify changes in adipose and blood mononuclear cell gene expression profiles as weight gain and adipotoxicity develop in a canine diet-induced obesity model. Key gene-metabolite relationships associated with weight gain and adipotoxicity will be identified by correlating mRNA abundance with physiological end-points such as adipose histological outcomes and blood metabolites.

Clinical Testing of the Antidiabetic Effects of High-Isoflavone Soy Protein*
William J. Banz, SIUC

Determine the therapeutic potential of a high-isoflavone soy protein supplement in individuals with Type 2 diabetes mellitus (DM) and exhibiting specific risk factors associated with the metabolic syndrome. Additionally, researchers will ascertain the importance of the isoflavone-enriched fraction to the insulin-sensitizing effects of high-isoflavone soy protein in individuals with Type 2 DM who exhibit risk factors associated with the metabolic syndrome.

College Students' Perceptions, Concerns, and Knowledge of Obesity, Body Image, and Health*
Aslihan D. Spaulding, ISU

Use survey instruments to collect data from college students concerning their perceptions, concerns, and knowledge of obesity, body image, and health. It will relate these observations to the respondents' reported food-consumption behavior.

Defining Protein Needs and Carbohydrate Tolerance for Adult Health

Donald K. Layman, UIUC

Determine (1) whether the amino acid leucine is the regulatory signal for muscle protein synthesis and a marker for adult protein requirements, (2) whether consistent macronutrient ratios across meals will optimize skeletal muscle protein synthesis and stabilize glycemic regulation, and (3) the relative impact of increased dietary protein versus moderation of dietary carbohydrate quantity and quality on improving glucose homeostasis.

Folate Produced in the Large Intestine by Probiotics can Mediate Colorectal Cancer Development via Epigenetic Mechanisms
Michael J. Miller, UIUC

Determine whether folate produced by probiotic bifidobacteria in the large intestine of humans can prevent the development of colorectal cancer.

High-Quality Protein Diets Decrease Insulin Resistance and Breast Cancer*
Donald K. Layman, UIUC

Examine the potential for diets with increased high-quality proteins and reduced carbohydrates to improve insulin sensitivity, reduce inflammation, and reduce breast cancer incidence. Researchers will use a new animal model of insulin resistance to evaluate the impact of chronic inflammation on breast tumor formation in rats.

Tomatoes and Broccoli for the Reduction of Prostate Cancer in Illinois African-American Men
John W. Erdman, UIUC

Increase prostate cancer awareness among African-American men through enhanced screening. Develop research-based recommendations for consumption of vegetables and vegetable combinations optimized for prostate cancer prevention. Develop research-based continuing education for health professionals in Illinois. Increase availability of these vegetable foods among African-American men in Illinois.

Use of Plasma for Destruction of Microbial Hazards in Food*
John D. Haddock, SIUC

The objective of the proposed research is to develop a novel technology based on ambient plasma to destroy biohazards in food. The research approach consists of controlled sample preparation, followed by plasma exposure and analysis of exposed samples for bacterial load and spoilage.

Research Focus: Natural Resources and Environment

A Watershed-Scale Assessment of the Water Quality Impacts of Riparian Buffers in Southern Illinois
Jon E. Schoonover, SIUC

Riparian ecotones are critically important transition areas along stream margins, as they provide the last opportunity for nutrient, sediment, and chemical attenuation before being transported to streams. These riparian buffers can be increasingly useful in southern Illinois, where agricultural fields commonly are not tile drained. This project will assess riparian zone vegetation for its sediment, nutrient, and fecal coliform attenuation performance at the watershed scale in southern Illinois agricultural watersheds.

Characterizing Corn for Grazing at Various Stages of Physiological Maturity*
Kenneth O. Nimrick, WIU

This research will determine the optimum economic stage of corn growth, including nutrient accumulation, to initiate grazing.

Costs and Environmental Benefits of Conservation Tillage in the Lower Illinois Basin
Jeffrey R. Beaulieu, SIUC

Study objectives are (1) to develop and statistically estimate an econometric model for evaluating responsiveness of conservation tillage adoption to economic factors, and (2) to use this model to assess economic, tillage intensity, and environmental consequences of changes in economic factors for the Lower Illinois Basin.

Degradation of Phytate and Lectins in Soybean Meal by Processing*
Kerry W. Tudor, ISU

Soybean meal will be subjected to various methods of feed processing to determine the degradation of antinutritional effects of phyate and lectins in rainbow trout diets.

Forage Radish: An Alternative Cover Crop for Organic Farms in Illinois*
Joel Gruver, WIU

Evaluate opportunities to enhance soil and water quality on organic farms by integrating forage radish within diversified cash grain production systems.

Implementation of No-Tillage Production Practices for Jack-o-lantern Pumpkins
S. Alan Walters, SIUC

The major limitation for implementing no-tillage practices in vegetable production is weed management. Improved weed management practices must be developed before no-tillage systems will be readily adopted. Implementing no-tillage vegetable production practices would be of tremendous benefit, not only to Illinois vegetable growers, but also to the future of Illinois agriculture through soil conservation.

Integrated Management of Summer Diseases of Apples
Mohammad Babadoost, UIUC

Evaluate the effectiveness of two disease-warning systems, an organic fungicide, and a reduced-risk fungicide oncontrolling apple diseases. It also will compare economics of the new IPM strategies with conventional practices.

Thermochemical Conversion Process to Produce Oil from Various Types of Livestock Manure
Yuanhui Zhang, UIUC

The research group has developed a thermochemical conversion process (TCC) and successfully converted up to 70% of fresh swine manure into oil. Researchers will investigate the feasibility of converting other types of livestock manure into oil using this TCC process.

EXTERNAL COMPETITIVE GRANTS PROGRAM

The External Competitive Grants Program funded the following initiatives in FY08.

Evaluation of Land Application Systems for Swine Manure to Reduce NPS Pollution
Paul M. Walker, ISU

Effect of Distiller's Grains on Beef Cow Dystocia and Conception
Rebecca L. Atkinson, SIUC

Organization, Financial Feasibility, and Rural Economic Impacts of Bioenergy in Illinois
Ira J. Altman, SIUC

Impact of Distiller Grain and Genetics on Beef Quality
Larry L. Berger, UIUC

Novel Cardiovascular Benefits of a Diet Enriched in Both Soy Oil and Soy Isoflavones
Kolapo M. Ajuwon, SIUC

Effect of Distiller's Grains on Fatty Acid Composition and Meat Quality in Steers
Rebecca L. Atkinson, SIUC

INTERNAL COMPETITIVE GRANTS PROGRAMS

The internal competitive grant programs at the University of Illinois at Urbana-Champaign (UIUC), Southern Illinois University Carbondale (SIUC), Illinois State University (ISU), and Western Illinois University (WIU) funded the following new initiatives in FY08.

Research Focus: Expanding Agricultural Markets

Evaluating Crude Glycerol, a Biodiesel By-product, as a Feed Supplement for Dairy Cows
Amer A. AbuGhazaleh, SIUC

Evaluation and Scale-up Research Capability for Ethanol Research
Vijay Singh, UIUC

Examination of Ethanol, Marketing, Input Procurement Practices, and Technological Flexibility of U.S. Ethanol Producers
Aslihan D. Spaulding, ISU

Identity-Preserved Grain: Will There Be a Market? A Survey of Illinois Grain Elevator Managers
Rick C. Whitacre, ISU

Impact of Vermicompost on the Establishment and Production Practices of *Maclura pomifera* for Utilization in Bioproduct Development
Gary R. Bachman, ISU

New and Alternative Crops for a Biobased Economy
Winthrop B. Phippen, WIU

Research Focus: Rural Economic Development

Multifunctionality (Postproductivism) of Agriculture: Measuring Non-Market Value of U.S. Agriculture
Wanki Moon, SIUC

Public Beliefs and Attitudes Concerning Wind Farms in Central Illinois
J. Randy Winter, ISU

Research Focus: Agricultural Production Systems

A Comparative Analysis of the Average Daily Gain and Feed Efficiency of Sheep and Goats
Mark D. Hoge, WIU

A New Approach in Deciphering the Interaction Between SDS and SCN
Jason P. Bond, SIUC

Can an Herb Restore Performance in Fescue-Fed Cattle?
Karen L. Jones, SIUC

Estimation of Soybean Cyst Nematode Genome Diversity: A Prelude to Association Mapping
Kris N. Lambert, UIUC

Identification of Pathogen-specific Apple Genes through Transcriptome Analysis during Interaction with the Fire Blight Pathogen *Erwinia amylovora*
Youfu "Frank" Zhao, UIUC

Improving Soybean Yield and Seed N Content by a Novel Inoculation Strategy
Brian P. Klubek, SIUC

Micropropagation Techniques for Wintergreen *(Gaultheria Procumbens)*
Marietta M. Loehrlein, WIU

Nitrogen Rates for Grazing Corn
Kenneth O. Nimrick, WIU

Towards a System Biology Approach to Networks for Metabolic Engineering and Crop Improvement of Soybeans
Gustavo Caetano-Anolles, UIUC

Research Focus: Human Nutrition and Food Safety

Feeding the Human Gut Microbiota with Health-enhancing Carbohydrates
David C. Hernot, UIUC

The STRONG Kids Project: Cross-disciplinary Investigation of Media Effects on Childhood Obesity and Health within Family and Community Contexts
Kristen Harrison, UIUC

Research Focus: Natural Resources and Environment

Environmental Effects of Swine Manure Application to Non-corn Crops
Kenneth D. Smiciklas, ISU

Establishing Groundcover Management Systems for Sustainable Vineyards
Bradley H. Taylor, SIUC

Exploring the Economic and Environmental Possibilities of Giant Cane as a Best Management Practice
Jon E. Schoonover, SIUC

STRATEGIC RESEARCH INITIATIVE PROGRAM

The Strategic Research Initiative Program funded the following initiative in FY08.

Biomass Energy Crops for Power and Heat Generation in Illinois: Diversifying Cropping, Improving Energy Security, and Benefiting the Environment

Agronomic Trials
Stephen P. Long, UIUC

Water Resource Implications
Mark B. David, UIUC

Miscanthus Breeding and Improvement
John A. Juvik, UIUC

Economic Analyses
Madhu Khanna, UIUC

Social Acceptability
Anne Heinz Silvis, UIUC

Propagating and Eradicating *Miscanthus x giganteus*
Thomas B. Voigt, UIUC

Carbon Sequestration and Greenhouse Gas Accounting
Michelle M. Wander, UIUC

Bioconversion
Yuanhui Zhang, UIUC

Financials

A complete financial accounting of C-FAR–appropriated funds is compiled and reported to the State of Illinois annually. This reporting is organized in detail by C-FAR's research and related support programs. The following pages detail all FY07 expenditures and FY08 allocations. A summary precedes the individual expenditure and allocation reports.

Summary of FY07 Expenditures and FY08 Obligated Funds

External Competitive Grants Program [a]		$1,492,751
Research Expenditures	584,619	
Research Obligations	906,373	
Scientific Reviewer Expenditures	0	
Scientific Reviewers Obligations	1,759	
University Internal Programs and Other Programs/Accounts [a]		$4,776,160
Research Expenditures	2,439,175	
Research Obligations	2,336,985	
Strategic Research Initiatives Program [a]		$1,038,212
Research Expenditures	686,554	
Research Obligations	351,658	
Scientific Reviewers Expenditures	0	
Scientific Reviewers Obligations	0	
Illinois Department of Agriculture Fee		$22,500
1% Member Expense Account		$29,078
Total - Expenditures and Obligated Funds		$7,358,701 [b]
Research Expenditures	3,710,348	
Research Obligations	3,595,016	
External Scientific Reviewers	0	
External Scientific Reviewers Obligations	1,759	
SRI Scientific Reviewer Expenditures	0	
SRI Scientific Reviewer Obligations	0	
IDOA Fee & 1% Member Expense	51,578	

[a] *Individual and detailed expenditure reports for these programs follow and are an integral component of this report.*
[b] *FY07 research expenditures and FY08 obligations are higher than the FY07 appropriation as a portion of funds from the previous fiscal year(s) were obligated for investment in the subsequent year(s) (i.e., multiple-year research initiatives).*

Summary of FY08 Allocations

External Competitive Grants Program	$681,270 [c]
(15% of the total appropriation, after IDOA fee and Member Expense)	
University Internal Programs and Other Programs/Accounts	$3,577,047
Strategic Research Initiative Program	$190,578
Illinois Department of Agriculture Fee	$22,500
($50,000, or ½ of 1% of the total appropriation, whichever is less)	
1% Member Expense Account	$45,000
(1% of the total appropriation)	
Total FY08 Allocations	$4,516,395 [c]

[c] *An additional $15,922 was allocated to the FY08 External Program due to distributing unexpended funds from the FY07 1% Member Expense Account and $473 unexpended from a previous External Program project. Therefore, the total FY08 External Program funding level is $681,270 and the total FY08 C-FAR allocation is $4,516,395.*

Please see additional notes on individual summary reports.

FY07 Expenditure Summary: External Competitive Grants Program

(July 1, 2006 – June 30, 2007)

Actual Fiscal Year Expenditures						
C-FAR RESEARCH FOCUS AREAS	**EXPENDITURE AREAS**	**UIUC**	**SIUC**	**ISU**	**WIU**	**TOTALS**
Expanding Agricultural Markets	Equipment	0	23,669	592	0	**24,261**
	Materials/Supplies	5,205	2,590	6,291	0	**14,086**
	Personnel	25,418	50,058	10,557	0	**86,033**
	Services/Contracts	79	20,917	25,200	0	**46,196**
	Transportation	0	1,387	993	0	**2,380**
Rural Economic Development	Equipment	0	0	0	0	**0**
	Materials/Supplies	790	349	0	0	**1,139**
	Personnel	24,397	17,924	0	0	**42,321**
	Services/Contracts	97	7,004	0	0	**7,101**
	Transportation	569	1,210	0	0	**1,779**
Agricultural Production Systems	Equipment	0	0	0	0	**0**
	Materials/Supplies	8,956	0	0	0	**8,956**
	Personnel	34,300	0	0	0	**34,300**
	Services/Contracts	96,130	0	0	0	**96,130**
	Transportation	786	0	0	0	**786**
Human Nutrition and Food Safety	Equipment	0	3,635	0	0	**3,635**
	Materials/Supplies	7,486	4,019	0	0	**11,505**
	Personnel	26,843	103,148	0	0	**129,991**
	Services/Contracts	97	6,522	0	0	**6,619**
	Transportation	1,865	1,863	0	0	**3,728**
Natural Resources and Environment	Equipment	0	0	0	0	**0**
	Materials/Supplies	20	0	0	0	**20**
	Personnel	32,470	0	0	0	**32,470**
	Services/Contracts	792	0	250	0	**1,042**
	Transportation	323	0	536	0	**859**
Subtotals		**266,623**	**244,295**	**44,419**	**0**	**555,337**
Indirect Cost		N/A	25,150	4,132	0	**29,282**
Scientific Reviewers		N/A	N/A	N/A	N/A	**0**
Unexpended/Obligated Funds for FY08 Research		556,281	324,394	25,698	0	**906,373**
Total FY07 Expenditures and Obligated Funds for FY08		**822,904**	**593,839**	**74,249**	**0**	**1,490,992**

FY07 Expenditure Summary: University Internal Programs and Other Programs/Accounts

(July 1, 2006 – June 30, 2007)

Actual Fiscal Year Expenditures							
C-FAR RESEARCH FOCUS AREAS AND PROGRAMS	**EXPENDITURE AREAS**	**UIUC**	**SIUC**	**ISU**	**WIU**	**FOOD AND AGRICULTURE RESEARCH ACT**	**TOTALS**
Expanding Agricultural Markets	Equipment	11,641	643	0	500	N/A	**12,784**
	Materials/Supplies	16,646	15,007	998	1,188	N/A	**33,839**
	Personnel	235,024	14,851	34,429	60,316	N/A	**344,620**
	Services/Contracts	10,640	7,428	1,703	678	N/A	**20,449**
	Transportation	11,731	989	2,913	493	N/A	**16,126**
Rural Economic Development	Equipment	1,424	0	0	0	N/A	**1,424**
	Materials/Supplies	418	0	0	0	N/A	**418**
	Personnel	133,957	7,551	9,073	0	N/A	**150,581**
	Services/Contracts	2,502	378	0	0	N/A	**2,880**
	Transportation	1,024	566	122	0	N/A	**1,712**
Agricultural Production Systems	Equipment	22,611	1,564	0	14,107	N/A	**38,282**
	Materials/Supplies	132,643	5,752	2,188	0	N/A	**140,583**
	Personnel	695,849	18,925	14,230	2,245	N/A	**731,249**
	Services/Contracts	115,032	4,037	780	0	N/A	**119,849**
	Transportation	10,947	1,091	0	0	N/A	**12,038**
Human Nutrition and Food Safety	Equipment	(2,417)	0	0	0	N/A	**(2,417)**
	Materials/Supplies	43,040	6,701	146	0	N/A	**49,887**
	Personnel	124,781	2,341	0	0	N/A	**127,122**
	Services/Contracts	12,875	4,829	1,500	0	N/A	**19,204**
	Transportation	11,965	0	0	0	N/A	**11,965**
Natural Resources and Environment	Equipment	0	14,022	0	0	N/A	**14,022**
	Materials/Supplies	(16,123)	1,726	517	536	N/A	**(13,344)**
	Personnel	0	38,119	18,387	2,032	N/A	**58,538**
	Services/Contracts	0	1,016	3,160	2,404	N/A	**6,580**
	Transportation	0	2,460	1,623	89	N/A	**4,172**
Subtotals		**1,576,210**	**149,996**	**91,769**	**84,588**	N/A	**1,902,563**
Indirect Cost		N/A	N/A	4,597	N/A	N/A	**4,597**
Research Support		66,057	168,343	163	0	N/A	**234,563**
C-FAR Administrative Office		243,911	32,720	11,898	8,923	N/A	**297,452**
Achievement Award	(included above)	N/A	N/A	N/A	N/A	N/A	**0**
1% Member Expense		N/A	N/A	N/A	N/A	29,078	**29,078**
IDOA Fee		N/A	N/A	N/A	N/A	22,500	**22,500**
Unexpended/Obligated Funds for FY08 Research		2,211,032	40,197	66,547	19,209	N/A	**2,336,985**
Total FY07 Expenditures and FY08 Obligated Funds		**4,097,210**	**391,256**	**174,974**	**112,720**	**51,578**	**4,827,738**

FY07 Expenditure Summary: Strategic Research Initiative Program

(July 1, 2006 – June 30, 2007)

Actual Fiscal Year Expenditures							
STRATEGIC RESEARCH INITIATIVES [1]	**EXPENDITURE AREAS**	**UIUC**	**SIUC**	**ISU**	**WIU**	**OTHER ENTITIES**[2]	**TOTALS**
Information Systems and Technology	Equipment	0	0	0	0	0	**0**
	Materials/Supplies	0	0	0	0	0	**0**
	Personnel	0	0	0	0	0	**0**
	Services/Contracts	(8)	0	0	0	0	**(8)**
	Transportation	0	0	0	0	0	**0**
	Coordination	0	N/A	N/A	N/A	N/A	**0**
Rural Community Development	Equipment	0	0	0	0	0	**0**
	Materials/Supplies	3,181	0	0	0	0	**3,181**
	Personnel	0	0	0	0	0	**0**
	Services/Contracts	0	0	0	0	0	**0**
	Transportation	0	0	0	0	0	**0**
	Coordination	N/A	N/A	N/A	N/A	N/A	**0**
Swine Odor and Waste Management	Equipment	7,318	0	0	0	0	**7,318**
	Materials/Supplies	1,772	0	0	0	0	**1,772**
	Personnel	4,889	0	0	0	0	**4,889**
	Services/Contracts	1,107	0	0	0	0	**1,107**
	Transportation	1,035	0	0	0	0	**1,035**
	Coordination	4,031	N/A	N/A	N/A	N/A	**4,031**
Food Safety	Equipment	0	0	0	0	0	**0**
	Materials/Supplies	0	6	0	0	0	**6**
	Personnel	0	0	0	0	0	**0**
	Services/Contracts	0	0	0	0	0	**0**
	Transportation	0	0	0	0	0	**0**
	Coordination	N/A	0	N/A	N/A	N/A	**0**
Water Quality	Equipment	0	0	0	0	0	**0**
	Materials/Supplies	13	0	0	0	0	**13**
	Personnel	0	0	0	0	0	**0**
	Services/Contracts	40	0	0	0	0	**40**
	Transportation	0	0	0	0	0	**0**
	Coordination	0	N/A	N/A	N/A	N/A	**0**

Biomass Energy Crops for Power and Heat Generation in Illinois	Equipment	5,602	0	0	0	0	**5,602**
	Materials/Supplies	23,286	0	0	0	0	**23,286**
	Personnel	203,586	0	0	0	0	**203,586**
	Services/Contracts	34,266	0	0	0	0	**34,266**
	Transportation	11,215	0	0	0	0	**11,215**
	Coordination	N/A	N/A	N/A	N/A	N/A	**0**
Illinois Livestock Integrated Focus Teams	Equipment	0	0	0	0	0	**0**
	Materials/Supplies	3,634	0	0	0	0	**3,634**
	Personnel	24,978	0	0	0	0	**24,978**
	Services/Contracts	24,104	0	0	0	0	**24,104**
	Transportation	5,519	0	0	0	0	**5,519**
	Coordination	N/A	N/A	N/A	N/A	N/A	**0**
Water Quality with a Focus on Nutrient Standards	Equipment	16,688	0	5,322	0	2,836	**24,846**
	Materials/Supplies	30,896	623	18,999	0	400	**50,918**
	Personnel	109,361	11,583	50,652	0	0	**171,596**
	Services/Contracts	42,294	223	4,410	0	0	**46,927**
	Transportation	11,553	5,075	1,826	0	0	**18,454**
	Coordination	11,168	N/A	N/A	N/A	N/A	**11,168**
Subtotals		581,528	17,510	81,209	0	3,236	**683,483**
Indirect Cost		N/A	2,747	0	0	324	**3,071**
Unexpended/Obligated Funds for FY08 Research		344,815	0	5,979	0	864	**351,658**
Total FY07 Expenditures and Obligated Funds for FY08		**926,343**	**20,257**	**87,188**	**0**	**4,424**	**1,038,212**

(1) Only the Biomass Energy Crops and Illinois Livestock Integrated Focus Teams SRIs were allocated funds in FY07. The other SRIs are continuing their research from previous fiscal year allocations.

(2) Other entity is Indiana University.

FY08 Allocations Summary

(July 1, 2007 – June 30, 2008)

C-FAR RESEARCH FOCUS AREAS AND PROGRAMS	UNIVERSITY INTERNAL PROGRAMS					EXTERNAL COMPETITIVE GRANTS PROGRAM [1]	STRATEGIC RESEARCH INITIATIVE PROGRAM	FOOD AND AGRICULTURE RESEARCH ACT	TOTAL ALLOCATIONS
	UIUC (82%)	SIUC (11%)	ISU (4%)	WIU (3%)	TOTAL INTERNAL UNIVERSITY ALLOCATIONS				
Expanding Agricultural Markets	429,000	90,000	45,687	62,714	627,401	83,854	N/A	N/A	**711,255**
Rural Economic Development	135,265	28,999	11,364	0	175,628	118,210	Biomass Energy 190,578	N/A	**484,416**
Agricultural Production Systems	1,291,484	19,439	0	35,000	1,345,923	229,077	N/A	N/A	**1,575,000**
Human Nutrition and Food Safety	725,988	0	0	0	725,988	125,260	N/A	N/A	**851,248**
Natural Resources and Environment	50,795	89,439	41,356	0	181,590	124,869	N/A	N/A	**306,459**
Scientific Reviewers [2]	N/A	N/A	N/A	N/A	N/A	0	0	N/A	**0**
Research Support	38,295	130,405	31,877	0	200,577	N/A	N/A	N/A	**200,577**
Research Discretionary	0	0	0	0	0	N/A	N/A	N/A	**0**
C-FAR Administrative Office [3]	250,051	33,543	12,198	9,148	304,940	N/A	N/A	N/A	**304,940**
Achievement Award	12,300	1,650	600	450	15,000	N/A	N/A	N/A	**15,000**
1% Member Expense	N/A	N/A	N/A	N/A	N/A	N/A	N/A	45,000	**45,000**
IDOA Fee	N/A	N/A	N/A	N/A	N/A	N/A	N/A	22,500	**22,500**
Totals	**2,933,178**	**393,475**	**143,082**	**107,312**	**3,577,047**	**681,270 [1]**	**190,578**	**67,500**	**4,516,395 [1]**

[1] $15,922 of unexpended funds from the FY07 1% Member Expense account and $473 unexpended from a previous External Program project were allocated to the FY08 External Competitive Grants Program (included in figures above).

[2] $1,759 of unexpended funds from the FY07 Scientific Reviewer account will be utilized for FY08. Therefore, no allocation from FY08 funds is necessary.

[3] The FY08 C-FAR administrative office budget is $310,173. This budget is met with $304,940 from the FY08 appropriation, $4,554 of unexpended FY07 funds and $679 from a previous year UIUC accounting adjustment.

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