Ohio State University Extension
3 Agricultural Administration Building
2120 Fyffe Road
Columbus, OH 43210-1084

Ohio Agricultural Research and Development Center
1680 Madison Avenue
Wooster, OH 44691-4096

March 30, 2007

Mr. Barton Hewitt
CSREES/Partnerships
US Department of Agriculture
Stop 2214
Washington, DC 20250

Dear Mr. Hewitt:

We are enclosing the FY 2006 AREERA Report of Accomplishments and Results for the College of Food, Agricultural, and Environmental Sciences, including the Ohio Agricultural Research and Development Center and Ohio State University Extension.

If you have any questions, please contact for research: Steve Slack (330-263-3987), Gary Mullins (614-292-3897) or for extension: Keith Smith (614-292-4880), Deborah Lewis (614-292-5089).

Sincerely,

Steven A. Slack
Director, OARDC

Keith L. Smith
Director, OSU Extension

Attached: FY 2006 AREERA Report of Accomplishments and Results

hard copies: Bob Moser
Deborah Lewis
Tom Archer

Federal Report of Accomplishments and Results (FY 2006)

The Ohio State University
College of Food, Agricultural, and Environmental Sciences
including
The Ohio Agricultural Research and Development Center
and
Ohio State University Extension

Goal 1. An Agricultural System that is Highly Competitive in the Global Economy

Executive Summary

Agriculture is playing a new and different role in delivering nutritional, pharmaceutical, and bio-based products; in providing sound stewardship of resources; and in supporting rural communities. Related technological breakthroughs take shape in new and innovative products used in everyday life. Energy, agrosecurity, economics, environment, societal well being, and a litany of other transformational issues are driving agriculture worldwide to invest heavily in knowledge and technology to help create new industries and transform traditional agricultural industries. To this end, The Ohio Agricultural Research and Development Center (OARDC) and Ohio State University Extension (OSU Extension), through the College of Food, Agricultural, and Environmental Sciences, continue to invest heavily in organizational transformation. Overall our collective mission is 'to bring knowledge to life'. With an emphasis on moving new research knowledge as rapidly as possible into society, via outreach and extension programs, traditional areas and new industries are creating new partnerships/ collaborations with our stakeholders to make Ohio agriculture more competitive in the global marketplace. OARDC and OSU Extension leverage base/capacity funding to attract support from competitive/extramural grants, partners, and government initiatives.

The well-being of Ohio's citizens and the state's economy are tied to environmental quality, food safety and quality, new technologies and enterprises, increasing the value of agricultural products, and generating and disseminating new knowledge. OARDC and OSU Extension are working for Ohio's citizens to conduct research, develop innovative technologies and products, and provide outreach and extension programs that address these priority areas.

By leveraging federal and state base/capacity funding through competitive processes, and by utilizing stakeholder input in the initial planning phase for programs, as well as scientific peer review, we are better able to define outputs and impacts within targeted knowledge areas, as illustrated in our 2008- 2012 Plan of Work. Increasingly stakeholders are less interested in making and growing things and more focused on ideas and innovation. Emerging areas such as biotechnology, genomics, and ecosystem science have also transformed the practices and products of agriculture and natural resources, collectively referred to hereafter as agriculture. These research activities (1) sustain and grow the Ohio economy, (2) protect, sustain, and improve the environment in Ohio, and (3) provide innovative solutions for Ohio's future.

Knowledge has replaced raw materials and human labor as the source of value, wealth, and economic prosperity. As reported in 2005, OSU's programs are positioning its agricultural bioscience/biotechnology, i.e. agbioscience, foci within knowledge-based industry clusters. Advances in agbioscience have shifted agriculture's foci well beyond food and fiber production, alone, toward goals of meeting energy needs, improving public health, addressing social well being, and fostering environmental well being. Meeting twenty-first century energy needs; delivering nutritional, pharmaceutical, and bio-based value-added products; providing sound

stewardship of natural resources; and supporting rural and urban communities are areas that OARDC and OSU Extension have repositioned themselves to contribute to on local, regional, national, and international scales.

To accomplish this within the research program, OARDC is focusing on transforming itself to fit twenty first century business models. Practices related to return on investment, industry partners/customer/stakeholder relations within a collaborative framework, competitive grants, and intellectual property have become standard business practices. For example, for every base/capacity dollar invested in research through OARDC's competitive grants program, $5.58 has been returned as a result of industry matches and extramural funding. Research partnerships have been developed with over 100 companies with private industry providing $3.2 million in support. Over the life of OARDC's competitive grants program, funded projects have contributed to obtaining $31.5 million in competitive grants. Eight U.S. patent applications have been filed as a direct result of these projects with two patents and three licenses being granted. To improve it's partnership with its stakeholders, OARDC has made substantial changes to its OARDC Advisory Committee.

Likewise OARDC continues to be guided in great part by its Battelle Research Review that has been reported in the 2004 and 2005 ROAs. This review provides a thorough understanding of OARDC's economic impact in Ohio and further provides an analysis of the organization's core competencies and agbioscience market opportunities.

To maintain focus on targeted programs identified in the 2008 – 2012 POW, a full understanding of value chains is needed in that these are now heavily influencing the research and extension agendas. With increased globalization, more trade liberalization, strong consumer preferences, and greater public concern about food safety and the environment, as well as changes in the relationship between agriculture and adjacent communities, the context in which OARDC and OSU Extension's programs are being conducted is changing rapidly. Thus the organizations are constantly learning and adapting.

Existing core strengths of OARDC and OSU Extension continue to be the basis for future gains. OARDC, OSU Extension, and our stakeholders, for example, lead an excellent and long-standing corn and soybean breeding and crop improvement program. Such programs will continue due to their economic importance, i.e. a total of two billion plus dollars per year and rapidly growing due to corn price increases. Thus, threats such as soybean rust continue to be addressed through aggressive research and extension education programs. OARDC and OSU Extension are considered national leaders in soybean rust due to the work of our scientists. For example, OSU's Dr. Anne Dorrance, a leading soybean rust pathologist, and other members of the National Soybean Rust Team, received the 2006 U.S.D.A. Secretary's Honor Award. American corn and soybean sectors are now expanding to include biobased products, including biofuels, thus expanding traditional crops into new industrial partnerships/markets.

The economic benefit from new and improved markets to Ohio and the region's economy has potential to increase dramatically. The utilization of Ohio's grain crops, and other biomass supplies, including agricultural waste streams, will continue to contribute to Ohio's 80 plus

billion dollar agriculture sector while feeding a growing demand for biobased products, including sources of alternative energy. Reliance on petroleum-based products is not sustainable and other sources of industrial feedstocks and energy sources must be researched, developed, and rapidly brought to market.

Further value can be added in this chain. For example, ethanol from corn results in large quantities of a by-product called distillers dried grains with solubles (DDGS). OARDC researchers have focused on expanding the use of DDGS as a high quality animal food by examining the current quality of existing products and looking at improving its value. Investment by OARDC in bioproducts and energy innovation programs is critical to meeting Ohio's future needs and to attracting private industry and global investments.

Cropping of any type will require innovation in farming techniques in order to produce quantity and quality required to be competitive in today's marketplace. An example is how application of geospacial referencing tools to Ohio's grape industry is proving to be a useful innovation.

Increased efficiency in plant and animal production is also a critical factor in advancing the agricultural industry in a highly competitive environment. Ohio ranks in the national top ten states in turkey production. While turkey sales in the Ohio are on the rise and the poultry industry itself has a total production value of $600 million dollars, there are still some commercial losses that are seriously impacting the industry.

Ohio's Commercial agriculture and horticulture industries depend upon Ohio State University Extension to provide timely and innovative, science-based, objective information that can be implemented within their management systems to remain competitive in our global economy. An innovative approach to problem solving, research and extension outreach is the use of empowered teams. A high priority for The Ohio State University Extension is the development and coordination of commodity/issue focused teams consisting of State/Regional Extension specialists, County Agriculture and Natural Resource Educators and research faculty from multiple disciplines to deliver high impact, research-based information and educational programming that is timely and easily accessed by Ohio's diverse commercial agriculture and horticulture industries.

Ohio State University Extension and the Ohio Agricultural Research and Development Center have currently engaged 26 multi-disciplinary self-directed teams ranging from our Agronomic Crops Team to our Watershed Management Network. These faculty-led teams interact closely with their respective state/national commodity organizations, state/federal agencies and environmental organizations to identify and develop OSU Extension statewide and multi-state/regional educational programming and future electronic and print communications and publications structure.

Team electronic communication networks are the keys for Ohio farmers and green industry professionals to access strategic information for global competitiveness. Many of our teams continue to develop weekly/monthly electronic newsletters and research updates that are

continually evaluated for their economic and behavioral impact. Our team members develop management newsletters following weekly tele-conferences such as: *Amazin' Graze, Buckeye Yard and Garden Line (BYGL), Crop Observation and Recommendation Network (CORN), Grain Marketing Research and Innovative Strategies (GRAINS), Pesticide Update (Pep-Talk), Pork Pointers, Veg-Net, Vineyard Vantage*, etc. Many newsletters are listed on our OSU Extension *Ohioline* web site, as well as many of our team's individual web sites for easier access by our stakeholders.

Ohio State University Extension engaged the Battelle Memorial Institute's Technology Partnership Practice to conduct an analysis of OSU Extension's economic impact on Ohio's key stakeholder industries. OSU Extension clearly provides a diverse range of product development, technology transfer, training, educational and advisory services for Ohio's agriculture sector. Using the "IMPLAN" Input-output data, Batelle calculated that OSU Extension had a minimum of a one percent increase in agricultural output representing $149 million in direct and indirect output, $29 million in personal income for Ohioans and 2,712 new jobs created. It should also be noted that expansion of the agricultural sector has benefits that can be felt in every county in the state.

Smith-Lever Fund expenditure for Goal 1: $1,396,442 EXTENSION FTE's: 20.0
Hatch expenditures for Goal 1: $3,715,393 OARDC FTE: 33.4

Goal 1 Key Themes

1. Key Theme: Agricultural Communications/Information Technologies

(Reference OSU Plan of Work Extension Program 1A: Summary of Extension Programs)

a. **Description of Activity** - Team electronic newsletters and fact sheets/bulletins through appropriate e-mail list serves and Web sites have been identified by Ohio clientele as preferred option to more traditional extension educational meetings. Many of OSU Extension's commodity-focused teams provided weekly/monthly electronic newsletters and research updates which have been evaluated for their economic impact. OSU Extension team members developed educational newsletter summaries following weekly tele-conferences titled: *Amazin' Graze, Buckeye Yard and Garden Line (BYGL), Crop Observation and Recommendation Network (CORN), Ohio Ag Manager (OAM), Pesticide Update (PEP TALK), Pork Pointers, Veg-Net, Vineyard Vantage* and the Watershed Network's *Buckeye Basins*. We have listed all newsletters on our OSU Extension *Ohioline* Web site, as well as many of our team's individual Web sites for easier access by our stakeholders/producer clientele and continually update newsletter list-serves.

b. **Impact** - Newsletter surveys have indicated that agronomic crop producers saved over $72 million dollars in chemicals used from implementing management

practices presented in the *CORN* newsletter and over $2.2 million from utilizing marketing/management tips found in our *OAM* newsletter. The OSU Extension beef team Web site, released in May 1997, had more than 14,400 hits during 2006. The *Buckeye Yard and Garden Line (BYGL)*, started in 1990, continues to be a key electronic educational tool developed by the OSU Extension Nursery Landscape and Turf Team for county Extension offices, the commercial green industry, and the gardening public. Estimates from the Ohio Nursery and Landscape Association place the economic benefit of the green industry state wide at over 4.3 billion dollars. In the 2005 *BYGL* Evaluation Survey, over 2,000 respondents indicated that *BYGL* saved their businesses over $4.1 million. Over 75% of the respondents indicated that the *BYGL* changed their pest management practices. Through newsletters, media and other sources, respondents indicated that *BYGL* reached over 2.4 million people in 2006. This version of *BYGL* web site is linked to thousands of plant and plant pest images and over 26,000 fact sheets from throughout the U.S. via links to the OSU Horticulture and Crop Science in *Virtual Perspective* Web site. In addition, *BYGL* is used throughout Ohio at universities as part of the curriculum for undergraduate horticultural courses.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

2. Key Theme: Value Added Products

(Reference OSU Plan of Work Research Program 1B: Value Added Products)

a. **Description of Activity** - OARDC optimizes various technologies, such as anaerobic digestion and fuel cells, for the conversion of Ohio's abundant biomass into scalable energy systems. Energy is a key driver in all sectors of the world economy and OARDC has positioned itself to be a key contributor to biobased energy research. Such systems are now reflecting full value chains as illustrated by one farm that uses anaerobic digestion to process manure from a swine operation mixed with waste materials from a nearby cheese plant to another farm that has as quarter-century old system that has been generating electricity from methane produced via anaerobic digestion of cow manure. Solids are dried using radiator and exhaust (methane generated) heat and then used for bedding and marketed as mulch. The liquid is used for irrigation.

Given the considerable interest in bio-conversion processes to generate energy to reduce costs for Ohio companies, Ohio's abundant agricultural and food-processing wastes are an untapped resource. These waste streams are capable of producing at least 65 percent of the state's residential electricity needs, according to the Ohio Public Utilities Commission, the Ohio Department of Development, and the U.S. Department of Energy. These resources, however, have not been tapped for their full potential and most often represent an environmental liability and financial burden to agribusinesses and food

manufacturers alike.

A federal funds match for OARDC's $1.5 million Third Frontier Project award provided by the state of Ohio in 2004 has supported initial advances in this area. With these allocations, OARDC is establishing a pioneering bio-energy research facility on its Wooster campus. The facility will include a set of 1,600-gallon anaerobic digesters especially designed to handle industrial food-processing wastes -- which are stronger than manure but can produce several times more energy. Also in the facility will be solid-oxide fuel cells, which can use either liquids or biogas to produce energy.

Besides being capable of handling a variety of fuels that are not clean, which is expected of renewable fuels, another plus of this fuel-cell system is that it is manufactured in Ohio by Cleveland's Technology Management Inc. (TMI) -- one of several OARDC industry partners in the project. Also being developed is an industrial-size facility that will allow businesses to test their feedstocks and calculate their potential energy yield. Interested industries would then be able to determine the feasibility of setting up their own biomass processing plants.

OARDC is not limiting their research to mega digesters that can cost up to $1.5 million. OARDC and Costa Rica's Earth University scientists are combining kitchen grease and other cafeteria waste with manure to increase efficiency of small biodigesters, some as inexpensive as $150 US. Preliminary results are showing that such additions can provide up to a three to four-fold increase in energy output.

Likewise as energy prices soar, particularly gasoline, the costs to consumers are expected to continue to climb. Ethanol from corn results in large quantities of a by-product called distillers dried grains with solubles (DDGS). OARDC researchers have focused on expanding the use of DDGS as a high quality animal food by examining the current quality of existing products and looking at improving its value. If ethanol production increases at the current pace, soon the quantity of DDGS being produced will outgrow that needed for ruminant diets.

DDGS has a high crude protein (27%) and fiber (40%) content making it a good feed source - for ruminants. Its use by non-ruminants such as swine and poultry though has been limited due to its high fiber content. Steeping DGGS with enzymes and acids was found to be better than simply adding the enzymes and acids before drying the DGGS. These findings enhance the digestibility of protein (i.e. amino acids), improving its energy utilization for swine and poultry, thus adding value. With such modifications, ethanol plants can become more profitable simply by increasing the sale of this by-product.

OARDC scientists have collected and evaluated DDGS samples from several plants in the Midwest finding inconsistent qualities among the various manufacturers. The more critical aspect that influences quality was found to be the drying temperatures of the wet fermented by-product. Drying distiller's grain by controlling the drying temperatures is now recognized as a critical component in regulating quality control issues.

On a parallel front, to advance the use of biofuels and the polymer

industry in Ohio, OARDC has joined with the University of Akron's Goodyear Polymer Center to develop the lightweight, bio-fueled 'Agri-Car' that may weigh 10000 pounds less than today's automobiles and achieves 70 – 80 MPG. Given that agriculture and polymers are the two largest industries in Ohio, such linkages are advantageous. This union builds on the 11.5 million dollar grant from the state of Ohio that established the Ohio BioProducts Innovation Center (OBIC) to advance plant-breeding programs to meet the polymer industries' demand for bio-based products as substitutes for petroleum-based polymers. OBIC is linking agricultural technologies with chemical-conversion and advanced-materials technologies to create specialty industrial compounds such as plastics, paints, lubricants, and solvents from crops such as corn and soybeans.

Further illustrative of OARDC's transformational practices which takes advantage of new opportunities to add value is the implementation of a program to produce American-grown rubber from a species of dandelion that originated in Kazakhstan and Uzbekistan.

b. **Impact -** Ohio has a significant base of dairies, and these operations can reclaim energy from animal waste via the use of methane digester technology. The economics of the conversion process are helped significantly if the post-conversion waste can be sold as organic fertilizer or used as livestock bedding material. A key problem associated with this byproduct re-use, however, has been the substantial pathogen load contained within the material. OARDC scientists have analyzed byproduct and characterized the microflora in the waste. This has enabled the team to develop approaches to the treatment of this waste to neutralize negative microbial content.

OARDC researchers have been working to significantly increase biogas yields through improvement of anaerobic digestion processes. A key approach in the OARDC work has been the introduction of enhanced levels of trace elements into waste feedstock. This "seeding" with trace elements results in an increase of between 60% and 200% in biogas yield. The commercial potential of this discovery is significant – making a substantial difference to the economics and return on investment of biomass waste-to-energy conversion equipment.

A key to the future success and viability of much more widespread bioenergy use is the conversion of lignocellulosic material into useable forms – such as fermentable sugars, biogases, and ethanol. An OARDC research team has undertaken in-depth study of microbial communities and their function in plant cell wall degradation. Using genomic analysis, these scientists are facilitating deeper understanding of the fundamental mechanisms involved in plant cell wall degradation leading to specific recommendations and potential technology for improving anaerobic digester operational efficiency and economic viability. Sand is commonly used as a bedding material in Ohio dairies, but the presence of significant quantities of sand in manure presents bioenergy generator equipment maintenance problems when the manure is processed in anaerobic digesters. OARDC has been working with industry on approaches to manage and recover the sand within digesters before it causes equipment damage. The new approaches provide for the economic use of dairy cattle waste for bioenergy

production.

OARDC agricultural engineers are focusing on the development of biomass combustion systems – particularly those using crop and crop residue as the primary fuel. A key goal of the OARDC team's work is the development of high-efficiency and automated combustion systems. A particular emphasis is being placed on fluidized bed combustion processes. Prior work by members of the team resulted in development and commercialization of an 8 million BTU/hr. flex-fuel combustion system, using the fluidized bed technology, which was installed at an Ohio greenhouse. Greenhouse operators found the system to be effective and cost-efficient, reducing overall energy expenditures by a substantial $200,000 annually. Currently the team has developed a fluidized bed combustion unit using shelled corn as fuel with a 65% combustion efficiency. The OARDC team is now working on refining the system with a more advanced third-generation model with goals of reaching 85-90% combustion efficiency.

Additionally, OARDC's efforts to develop small, inexpensive, highly efficient biodigesters for developing countries reduces energy costs, prevents destruction of forests for fuels, and increases agricultural production, as well as improves overall quality of life. Collectively all these efforts contribute to the world's energy solutions.

Other OARDC research results demonstrate that soaking DDGS in water (i.e., steeping) with added enzymes and acids increases digestibility for non-ruminants such as swine and poultry. These results also show that enzyme supplementation increased both the energy and amino acid digestibility among all major livestock and pet species and thus improved the quality and value of the product.

On another related front, value is added when DDGS quality is increased. Color of DDGS was found to be a good indicator of quality with lighter colored products generally being of better quality. DDGS manufacturers often times apply excessive heat in an attempt to quickly complete the drying process and unknowing reduce the quality and value of their product. Thus adherence to OARDC's recommended drying regimes increases product quality and value.

While OARDC's research using grease to enhance fuel production in small scale generators, building agri-cars for the future, and making rubber from dandelions are not at the stage yet to yield significant tangible impacts, they are reported as surrogate measures to illustrate how OARDC is transforming its research program to add value and improve value chains. Institutional realignment to take full advantage of emerging value chains is in progress.

c. **Source of Federal Funds** - Hatch

d. **Scope of Impact** - State Specific

3. **Key Theme: Innovative Farming Techniques**

(Reference OSU Plan of Work Research Program 1C: Innovative Farming Techniques)

a. **Description of Activity** - Innovation is the key to success of any new or existing

agricultural enterprise. The wine industry and grape juice industry are growing in the state of Ohio and are currently valued at more than $70-million and $10-million dollars, respectively. Grape growers, like producers of any horticultural crops, are faced with challenges as they attempt to maximize production and profitability while producing a uniform product. They have long realized that even identical biological factors such as variety, clone, and rootstock in a vineyard produce grapes of varying maturity and wine quality. Due to lack of methods that help in identifying and quantifying variability, uniform management practices continue. However, information technologies and tools such as global positioning system (GPS), geographical information systems (GIS), remote sensing, and proximal soil sensing, having proven successful in managing variability in field crops, offer opportunities to acquire detailed geo-referenced information about vineyard performance. These are being utilized to identify site-specific management strategies to optimize productivity in terms of both yield and quality. OARDC scientists found a three-fold variation in grape yield in their studies, information that was unknown to the grower. Aerial imagery and a GreenSeeker sensor provided useful information about crop canopy status and help explain yield and quality variability.

b. **Impact** - The adoption rate of precision agriculture by Ohio farmers over the past several years has been growing and that trend is expected to continue as prices fall, availability of equipment increases and farmers grow more comfortable with the use of the technology. In one Ohio study, a grape quality map created by picking berries from locations guided by remote sensor information lead to the division of fields into high and low quality zones. The grapes from the low quality zone were harvested a week later than the high quality zone to ensure similar quality. This and other data gathered over a two-year period are helping growers to understand the importance of maintaining optimum fruit load on vines. Armed with the quantitative yield data, the grower now has confidence in making management decisions about replacing those vines that performed below expectations. These findings are potentially applicable to most vineyards.

c. **Source of Federal Funds –** Hatch

d. **Scope of Impact –**Multi-state

4. Key Theme: Increased Animal Production Efficiency

(Reference OSU Plan of Work Research Program 1D: Increased Animal Production Efficiency)

a. Description of Activity - The farm income for turkey production in the United States was 3.23 billion dollars in 2005. The major world turkey breeders normally cross a sire line to a dam line to produce commercial turkeys. The sire lines are normally selected primarily for growth-related traits while the major emphasis in dam lines is on egg production. The turkey industry's view of the relative economic importance of growth and egg production has changed rapidly. Genetic changes by selection within lines may not be rapid enough though to meet the changing needs. OARDC scientists tested the feasibility of rapidly increasing the body weight of dam lines by repeated backcrosses of a dam line to a sire line. After three generations of backcrossing, the backcrosses exhibited a gain in 20-week body weight of 12.5 and 8.8 kg, respectively, for males and females; a gain of 5.9 and 5.3 cm in breast width at 16 weeks of age for males and females, respectively; and a loss of 74.1 eggs per hen over a 180d egg production period.

Another trend in the poultry industry has been to select birds with increased growth rate and muscling. Although growth rate, feed conversion, and muscling have improved in meat-type birds, meat quality has been altered. On example of a meat quality problem experienced by the turkey processing industry is a condition similar to the pale, soft, and exudative (PSE) found in swine. Turkey PSE meat-- when cooked-- has a soft texture, poor meat binding, poor juiciness due to reduced water-holding capacity, and increased yield losses. Approximately 40% of commercial turkey meat exhibits poor water-holding capacity that represents a significant financial loss to the poultry industry.

The change in meat quality largely results from a dearth of information concerning the effect of growth selection on the biological mechanism of muscle formation and growth. OARDC scientists have addressed this by identifying gene expression parameters associated with enhanced muscling.

Another animal production efficiency study, O'GIFT (Ohio Genetic Improvement of Farmed-fish Traits) program with yellow perch and bluegill, has evaluated growth and feed conversion ratio of different new aquaculture strains at different temperatures for a selective breeding program. The genetically improved lines grow significantly faster than unimproved groups. A new color-coded chart of genetic relatedness was developed for selecting the least related individuals that had the preferred phenotypes. These are increasing aquaculture production. OARDC researches are also working on management systems to improve the economic and environmental sustainability of dairy enterprises. One project involves exploring a sampling schedule for an X-bar chart to optimize forage sampling on dairy farms. This is defined by three parameters: the number of samples n, the sampling frequency h, and the control limit L yielding the total quality cost (TQC). A TQC function consists of cost per cycle while the process is in-control, cost per cycle while the process is out of control, cost per cycle for

sampling and analyses, and the expected duration of a cycle. The model appears very robust to departure from normality, presence of outliers, and a skewed distribution of measurements. Because of its robustness, the model can be confidently applied to optimize forage sampling on dairy farms, with expected savings ranging between $80 and 100/cow/y.

In a different dairy study, OARDC scientists sought to determine whether corn silage hybrid affected protein requirements of lactating dairy cows and how corn silage hybrids effected excretion of manure and nitrogen (N) by lactating dairy cows. The major findings were: 1) Increasing dietary protein increased urine excretion by about 25% but because of a tendency of decreased wet fecal output, manure output was only increased by about 5%. Feeding brown midrib silage reduced output of total manure by about 5%. Cows fed brown midrib silage excreted less N at a specific N intake than cows fed conventional corn silage (approximately 15 g/d less). 2) Milk production increased significantly within two days of supplementation in high producing cows but yield did not change with low producing cows. The differential response of milk yield to supplemental biotin did not mirror changes in biotin status (i.e., both production groups had similar changes to biotin status when biotin was fed).

b. **Impact -** The turkey industry raised an estimated 266.5 million turkeys in 2006. The average consumption of turkey meat was 16.7 pounds per person. The farm income for turkey production in the United States was 3.23 billion dollars in 2005. The United States turkey industry exported 388.6 million dollars worth of turkey meat in 2005. The growth rate of turkeys is largely controlled by their genetics. Gains in growth rate by genetic selection or manipulation the mating system by commercial turkey breeders can have a major economic impact on the turkey industry. An improvement of 0.5 percent in the genetics of the commercial turkey would have a farm value of 161.5 million dollars based on 2005 values. OARDC has reported that limited backcrossing of a dam line to a sire line is an economically feasible method to greatly increase the body weight of dam lines without unduly sacrificing egg production.

In further turkey research, OARDC scientists examined the expression for four different heparan sulfate proteoglycans in turkey breast muscle in a growth selected and non-growth selected turkey lines. The results indicated that each of the heparan sulfate proteoglycans had distinct expression patterns suggesting that they play different roles in the regulation of muscle growth. Findings from this gene expression research are being used as a basis to address signaling mechanisms that are likely to be regulated by each of these proteoglycans in the control of muscle growth. This discovery brings the state and national poultry industry one step closer to unlocking the key to optimal muscling gene expression in turkeys.

Aquaculture is an expanding Ohio industry. Aquaculture sales in Ohio have nearly doubled from $1,788.000 in 1997 to $3,185,000 in 2005. Nationally, Ohio ranks first in pounds of yellow perch sold and fourth in sales of sport fish. Previously unranked, aquaculture is now ranks fifteenth in Ohio for value of agriculture products sold. The results from OARDC's strain evaluation of

selective fish breeding allows for establishment of a marker-assisted breeding program that can improve growth rate by 15-20% per generation. The new information from muscle studies will be useful in identifying gene products unique to enhanced muscle growth and development and will allow for producers to develop useful breeding strategies for the production of yellow perch. The OARDC aquaculture program is having substantial effects on aquaculture operations in northwest and central lake counties in Ohio. The program has drawn many stakeholders interested in aquaculture to visit the Bowling Green facility, and has generated positive publicity for the expansion and development of Ohio aquaculture. Several stakeholder-working relationships have established thus expanding the industry and promoting adoption of a new industry and new technologies.

OARDC dairy research is also increasing production efficiency. OARDC scientist have developed a model that can be confidently applied to optimize forage sampling on dairy farms, with expected savings ranging between $80 and 100/cow/y. This equates to cost savings of $ 21.6 to $ 270 million per year for Ohio, and $720 to $910 million per year for the US.

In another dairy study, social, environmental, and economic costs associated with manure are considered. OARDC scientists found that manure output by dairy cows could be reduced by about 5% (equal to approximately 7 lbs./cow/day) by feeding brown midrib silage as compared to conventional silage. Feeding lower protein diets (less than current recommended standards) greatly reduced excretion of nitrogen by dairy cows but did not significantly effect milk production. Simple diet manipulations can be used to reduce the many costs associated with manure. In the second experiment OARDC reported that only early lactation cows responded to biotin supplementation. If cows are grouped by stage of lactation, this finding will allow targeted supplementation that will reduce feed costs and increase economic return to biotin supplementation.

c. Source of Federal Funds – Hatch

d. Scope of impact – Multi-State

5. Key Theme: Plant Production Efficiency

(Reference OSU Plan of Work Research Program 1E: Increased Plant Production Efficiency)

a. Description of Activity - In an OARDC study, diseases that pose serious threats to pumpkin crops - powdery mildew, downy mildew, Microdochium blight, and watermelon mosaic virus - were the foci. Powdery mildew can be controlled by fungicide application but costs may be high and prohibitive. Powdery Mildew Tolerant (PMT) varieties have been introduced into Ohio and these varieties can help lower disease costs associated with disease control as well as the amount of fungicide entering the environment. Downy mildew control may require one to several applications of a high cost fungicide such as strobiluron. Two pumpkin

varieties were studied using both organic and inorganic fungicides to control bacterial and fungal diseases. At the end of the season foliar evaluations were made to determine the percent severity of foliage infected with Powdery Mildew, Downy Mildew and other prominent diseases. In addition, yield data such as handle quality (the presence or absence of powdery mildew), average fruit weights, number of fruit per acre, tonnage per acre and fruit disease susceptibility were recorded. These findings support efficiency in plant production system.

A soybean study resulted in the identification of several biotypes of common lambsquarters and giant ragweed with reduced sensitivity or a low level of resistance to glyphosate. Glyphosate resistance in Ohio is of major concern to the soybean industry. These biotypes were collected from soybean fields with a history of glyphosate-resistant soybeans and intensive glyphosate use. Field and greenhouse studies were conducted in Ohio in 2006 to: 1) characterize the response to glyphosate of giant ragweed biotypes that survived glyphosate treatment in growers' fields; and 2) develop strategies for control of common lambsquarters and giant ragweed biotypes with reduced response to glyphosate in no-tillage glyphosate-resistant soybean. Resistant giant ragweed plants survived multiple glyphosate treatments at all field sites, and the effectiveness of standard giant ragweed control programs was reduced, compared to a glyphosate-sensitive biotype. Several treatments provided adequate control of resistant ragweed biotypes, but even the most effective treatments resulted in plant survival and seed production at the time of soybean harvest. The most effective treatments for control of glyphosate-resistant giant ragweed contained all of the following components: 1) preplant treatment of glyphosate and 2,4-D ester; 2) preplant herbicides with residual activity on giant ragweed; and 3) multiple postemergence glyphosate treatments, where the first postemergence treatment consisted of either the highest labeled rate of glyphosate or fomesafen as an alternative to glyphosate.

In other soybean work, one hundred ninety eight soybean varieties were evaluated for yield, relative maturity, disease resistance (*Phytophthora, Sclerotinia*), plant height and lodging, seed size, oil and protein content at six locations throughout Ohio. Almost 36,000 copies of the performance trial report were distributed. In additional field trials, fifty nine soft red winter wheat varieties were evaluated for yield, test wt., seed size, lodging, plant height, heading date, and level of powdery mildew infection, and flour yield and softness.

USA and China soybean history is linked with soybean being produced in China for 3000 years and in the US for more than 200 years. Being from similar genetic bases, breeders in China and North America have selected for adaptation to their respective environments, resulting in increased yield and improvements in other traits. Future yield gains may depend on an understanding of the changes made to soybean cultivars by breeding and selection. OARDC scientists determined how selection in one environment (China or USA) has led to similar improvements in the other environment. Knowledge of how morphological and physiological traits have responded to selection provides insight as to the nature of the genetic changes. The OARDC researchers compared, in both Liaoning

province (China) and Ohio (USA) environments, a set of older cultivars from Liaoning with their modern counterparts derived from breeding programs in Liaoning and Ohio. The results show that a significant portion of the yield gains made by breeders in each location translates to the other location. Exchange of cultivars should benefit breeders in both countries.

In further soybean research, purple deadnettle, a winter annual weed of the U.S. Corn Belt and a strong alternate host of soybean cyst nematode (SCN), was studied. Field experiments were conducted in continuous; no-till susceptible soybean plots from 2001 to 2006 to determine the effect of purple deadnettle emergence time and removal time on SCN reproduction. Results indicate that SCN population increases in soil, measured as final egg population density/initial egg population density, were generally higher in purple deadnettle-infested plots than in weed-free soybean plots and increased SCN populations 20 to 33% when the weed emerged in October. The time of removal experiment indicated that SCN population growth was significantly lower if purple deadnettle was removed in the fall (Oct. - Nov.) compared to removal in the spring (March – May).

b. **Impact -** Diseases such as powdery mildew, downy mildew, Microdochium blight, and watermelon mosaic virus pose serious threats to crops. OARDC scientists have documented that fungicide spray programs actually had no affect on pumpkin fruit number per acre. Fungicide spray programs did affect the percent severity of powdery mildew on the bottom of the pumpkin leaves. The low cost program had a significantly higher incidence of infection compared to all other treatments regardless of variety. On the top of the foliage, powdery mildew control was virtually the same among treatments. Only the low cost-Pro Gold combination had significantly more powdery mildew than the intensive-Super Herc and standard-ProGold combinations. The standard fungicide program remains the best recommendation. It was the cheapest in cost and had the lowest environmental impact.

OARDC research continues to show an increasing occurrence of glyphosate resistance in Ohio that is of major concern to the soybean industry. Glyphosate resistance in horseweed now occurs in most counties in the western half of Ohio, and some of these are also resistant to herbicides that inhibit acetolactate synthase (ALS). Control of the latter can require a very specific combination of herbicides and the appropriate application timing; failure of growers to properly implement control measures is likely to result in poor control and soybean yield loss. In 2006, OARDC scientists confirmed the occurrence of glyphosate resistance in several giant ragweed populations as well. The development in additional growers' fields of lambs quarters and giant ragweed biotypes with a low level of resistance to glyphosate should occur with increasing frequency in the near future. Control of these biotypes is possible with modifications to glyphosate-based herbicide programs, but will increase the cost of growers' weed management programs. Glyphosate resistance in giant ragweed could be extremely problematic due to the widespread occurrence of ALS resist in this weed, and the development of multiple resistance will result in relatively few options for control.

Soybean cyst nematode (SCN), another research front, is the most economically important pathogen of soybeans worldwide. Purple deadnettle, a common winter annual weed of the U.S. Corn Belt, contributes to increases in SCN populations under field conditions by acting as an alternate SCN host. Overall results of OARDC research indicates that purple deadnettle can contribute significantly to SCN population growth in the absence of soybean, and that its establishment in the fall should be prevented or controlled within three weeks after it emerges to prevent additional buildup of SCN populations in infested fields. Elucidating the interaction between purple deadnettle and SCN has allowed soybean growers to manage SCN infestations more effectively by the use of timely weed control measures and elimination of alternate hosts. Understanding the nature of the interaction between SCN and winter annual weed hosts supports development of novel Integrated Pest Management strategies for the U.S. Corn Belt.

In another soybean program scientists assessed the genetic gain for yield and other transits that have been achieved by soybean breeders operating independently, but starting from similar genetic bases, in Liaoning province, China, and Ohio, US. Breeders in both places have made progress in improving yield, and it appears that a significant portion of yield gains made in one location translate to the other. Changes in protein content and lodging resistance were equivalent between the two countries, reflecting different goals of the breeding programs. The results suggest that exchange of breeding material between China and US is mutually beneficial.

Soybean trail data, an important service provided to Ohio growers, assisted them in selecting more productive varieties for their fields resulting in an estimated yield increase of 14 kg/ha over 1.55 million hectares worth $5,800,000. These data have assisted producers in selecting more productive varieties for their fields resulting in an estimated yield increase of 10 kg/ha over 0.45 million hectares worth $1,500,000.

c. **Source of Federal Funds** - Hatch

d. **Scope of Impact** – Multi-State

6. Key Theme: Animal Health

(Reference OSU Plan of Work Research Program 1F: Enhancement of Animal Health)

a. **Description of Activity** - Calf morbidity and mortality associated with bovine respiratory disease is estimated to cost the U.S. beef industry approximately $500 million annually. Onset of respiratory disease results from high stress levels, poor feed intake, and a compromised immune system in calves after arrival at the feedlot. A novel approach for delivering nutrients required to support the immune system in an encapsulated form has been developed. Enhanced consumption and small intestinal absorption of these nutrients were achieved via a capsule. Liposome encapsulation methodologies to increase availability and absorption of

fat-soluble vitamins, B vitamins, selenium, zinc and chromium are known to enhance immune-competency. Two experiments were conducted to evaluate the effectiveness of liposome-encapsulated nutrients to improve the health, performance, and humoral immune response of weaned steers, new to the feedlot environment. A third study evaluated the stability of thiamine-fortified liposomes during rumen fermentation in vitro. Development of liposome formulations to encapsulate vitamins and minerals were successful.

In another animal health study, OARDC scientists are focusing on Johne's disease (JD), a chronic intestinal disease of ruminants including domestic and wild species caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP). It has been estimated that at least 40% of herds in the US with more than 300 animals per herd are infected. JD has also been predicted to impose an economic burden of $1.5 billion annually to the US agricultural industry. Furthermore, it has been implicated as a possible etiological agent of Crohn's disease (CD) in humans. Despite considerable research efforts prevention and control strategies of JD remain a distant task.

MAP persistently infects and survives within the host cells called macrophages. Currently, there are no reports on the behavior of diverse clinical isolates of *M. paratuberculosis* within a host/host cell (macrophage). This critical piece of evidence is important to understanding the complex mechanisms underlying the virulence of this economically important animal pathogen. Comparative gene expression of clinical isolates of MAP in a bovine monocyte derived macrophage (MDM) environment was studied. Selective capture of transcribed sequences (SCOTS) was effectively employed to identify the genes expressed by a MAP strain (MAP6) isolated from a Crohn's disease patient. cDNA libraries were created from macrophages exposed to MAP.

Avian influenza remains another major animal industry and human health concern. OARDC is creating a more effective, cheaper, easier-to-use and faster-to-produce vaccine to protect poultry from avian influenza. High-pathogenic avian influenza is one of the top threats facing the poultry industry and, because of the spread of the Asian H5N1 virus strain, it also poses a major human health risk. A live attenuated influenza vaccine would give poultry a more cross-protective and longer-lasting immunity against high-pathogenic avian flu viruses - a key weapon to protect an industry worth more than $20 billion in the United States and $3.3 billion in Ohio. OARDC scientists are leading the effort to develop such vaccine.

Additionally OARDC's Center for Diagnostic Assays (CDA) has come up with a first-of-its-kind test for the detection of very virulent infectious bursal disease virus (vvIBDV), a highly contagious disease in poultry. A validated real-time RT-PCR assay (patent pending) for the rapid detection of nucleotide sequences that are unique to vvIBDV strains affecting poultry operations all around the world has been developed. This new assay distinguishes vvIBDV strains from non-vvIBDV classic and variant strains.

IBDV, unlike the highly pathogenic avian flu, does not affect humans. It is though an immuno-suppressive disease that attacks young birds, killing them or

making them more susceptible to other infectious agents. In addition, this disease can quickly produce mutated viruses that are resistant to vaccines. IBDV has troubled egg and broiler operations in the United States since the 1950s, and recent studies show the incidence of variant IBDV strains is increasing throughout the country.

b. **Impact** - Delivering nutrients required to support the bovine immune system in an encapsulated form has been evaluated at OARDC in 2006. Overall growth and feed intake were not affected by source of supplement. However there were many promising findings that resulted from the use of liposome protected minerals and vitamins. For newly weaned feedlot calves that are at high risk for respiratory disease, feeding liposome protected minerals and vitamins reduced morbidity and delayed the progression of respiratory disease out-break. OARDC is now engaging various industry partners about market opportunities for this specific technology and intellectual property rights are being explored.

Another OARDC animal health study addresses the bovine and the human Johne's disease (JD), a chronic intestinal disease of ruminants including domestic and wild species caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP). The Center reported that MAP isolates lead to anti-inflammatory and anti-invasive pathways in the macrophage environment whereas, in sheep, the MAP led to a more pro-inflammatory pathway. Thus, the infecting strain genotype may play a role in polarizing the host immune responses and dictate the linicopathological outcomes in this economically important disease. These findings also pave the way for identifying genotype-specific host pathogen interactions eventually enabling scientists to design intervention strategies such as vaccines and early diagnostic tests.

According to the U.S. Department of Agriculture (USDA), poultry is the fastest-growing component of global meat demand. The United States is the world's largest poultry producer and the second-largest egg producer and exporter of poultry meat, with an annual farm value exceeding $20 billion. Currently, the only type of avian-flu immunization tool available to poultry operations in the United States is inactivated vaccines - a less effective and more costly option for farmers in that the vaccine must be administered by intramuscular injection, one bird at a time. Live-virus vaccines can be developed faster to respond to emerging virus strains and can be administered via aerosol for faster, cheaper and more effective control according to the scientist. At this point OARDC is testing six different vaccine candidates in embryonated chicken eggs. The best candidate will be the one that does not kill the egg (attenuated virulence) but induces strong immune response and would not transmit the virus to clean (unvaccinated or uninfected) birds. The vaccines will protect chickens against H5 and H7 viruses and can be adapted to other subtypes, such as H3 that is causing serious problems in the turkey industry. While this research will directly impact the poultry industry, what is learned could also contribute to ongoing efforts to develop fast and effective vaccines to protect humans from the H5N1 virus - or any other high-pathogenic subtype that may show up in the future.

Managing the poultry industry also requires protection from very virulent

infectious bursal disease virus (vvIBDV). The vvIBD is causing major losses to a multibillion-dollar industry worldwide and is threatening to invade the United States. In countries with vvIBDV, this assay is necessary for the effective monitoring and control of this devastating disease. In countries without the virus, the assay would be a first line of defense needed to prevent vvIBDV from entering domestic poultry operations. This reliable and economical assay for vvIBDV will help control the destructive disease caused by this virus. And the countries that do not currently have vvIBDV, such as the United States and Australia, are interested in keeping the disease at bay by monitoring imported poultry for vvIBDV. In 2004 alone, the United States imported over 18 million chicks and 9 million hatching eggs. Should the vvIBDV reach the United States, the assay is critical to initial diagnosis and subsequent eradication of the agent from our chicken flocks, a $3.3 billion industry in Ohio. Additionally this line of work represents a major collaborative effort. USDA's Animal and Plant Health Inspection Service (APHIS) helped OARDC secure part of the funding for this work from the U.S. Poultry and Egg Association and granted the Center permission to obtain vvIBDV genomic material from all over the world.

Overall, OARDC research scientists have developed multiple vaccines for animal and livestock diseases. Some of the key technologies developed at OARDC are the Rotavirus Vaccine that provides swine complete protection against rotavirus intestinal disease and Infectious Bursal Disease Virus Vaccine (IBDV) for prevention of this immuno-suppressive disease in poultry. The rapid assay work of OARDC ties into the vaccine work, allowing diagnosticians to identify the best vaccines to use, e.g., with particular IBDV strains.

c. **Source of Federal Funds** - Hatch

d. **Scope of Impact** – Multi-state

7. Key Theme: Plant Health

(Reference OSU Plan of Work Research Program 1G: Enhancement of Plant Health)

a. **Description of Activity** - Plant health research continues a major research focus at OARDC. Yield and profitability of grain crops are significantly reduced by soil borne plant diseases. The pathogens that cause seedling diseases of soybeans, corn, and wheat are widespread in soils and represent a significant constraint to production worldwide. Soil and climatic conditions throughout Ohio are generally conducive to soil borne plant diseases; farmers must carefully manage these diseases to remain profitable. Losses to soil borne plant diseases are estimated to be in the tens of millions of dollars annually in Ohio.

The pathogens that cause these losses may be partially controlled by good cultural practices, but chemical and biological seed treatments can still control pathogens and significantly increase crop stand, seedling vigor, and, ultimately, yield and profitability. OARDC scientists are identifying beneficial microbes with the capacity to colonize roots and suppress these plant pathogens. By isolating

and applying these beneficial bacteria directly to seed before planting, farmers can increase the level of protection afforded by these microorganisms, thereby reducing root damage and increasing vigor of the crop.

Another OARDC study addresses tomato production. Ohio is third in U.S. tomato production for processing and fresh market, with annual values of 89 million dollars. It is estimated that Ohio tomato growers lose 10% of their annual yield to bacterial pathogens (including bacterial speck). The susceptibility of tomatoes to bacterial infection adds both production and environmental costs that exceed those of yield and quality. This research focused on *Pseudomaonas* bacteria that cause many plant diseases, including bacterial speck of tomato. The study of innate immunity in plants also improves understanding of immune function in animals.

An OARDC gene silencing study determined the key genes in soybean by focusing on host defense against pathogens. In studying soybean pathogen *Phytophthora sojae*, scientists determined that silencing genes for both secondary product metabolites and PR proteins had dramatic effects on resistance to *P. sojae*. A primary discovery was that, in soybean lines carrying resistance genes at the Rps-1 locus, the isoflavones participated in the activation of hypersensitive cell death. This is a critically important finding and the first example suggesting that different race-specific genes trigger different mechanisms of cell death. It has very far-reaching significance to breeding efforts since knowing that different Rps genes either work in a similar or very different manner will allow us to better deploy those genes. "Stacking" of race-specific resistance genes is one way to increase the effectiveness and stability of resistance.

In another pathogen study, rice blast is well documented as the leading cause of yield loss of rice worldwide. All parts of the plant, including roots, are subject to attack, but an infection that occurs immediately below the panicle is most destructive, virtually ensuring a complete loss of rice. *Magnaporthe grisea* is known for its high variability in field conditions, which causes frequent loss of host resistance. The annual yield loss due to the disease is about $5.0 billion dollars worldwide. These results suggest that sequence diversification in 5' regulatory region and N-terminal intron of the paralogues may have led to suppression of meiotic recombination between the paralogues within each haplotype, facilitating the maintenance of the orthologous relationship among rice cultivars. These scientific observations provide valuable insight into the genomic dynamics and evolutionary mechanism of an NBS-LRR resistance gene complex in rice.

OARDC is using a variety of approaches to investigate the diversity, activities, and responses of plant pathogens and their antagonists in agricultural systems. This includes biogeography of plant pathogens such as tomato rot. Here, the biological control of plant pathogens by *Bacillus subtilis*, and the effects of field management on rhizosphere bacteria that suppress soil borne diseases are critical to production. Bioassays indicated that the mutants were significantly less able to suppress *Rhizoctonia* root rot than the wild-type parent strain. Bacterial population structure in bulk soil and the rhizosphere of both crops were also

characterized. OARDC scientists also study bacteria that colonize roots and naturally suppress plant pathogens.

A *Pseudomonas* project found that the incidence and relative abundance of root-colonizing phlD+ *Pseudomonas spp.* were influenced by crop rotation, tillage, organic amendments, and chemical seed treatments in subtle but reproducible ways. In no-till corn plots, two-year rotations with soybeans resulted in plants with approximately two-fold fewer pseudomonads per gram of root, but three-year rotations with oats and hay led to population increases of the same magnitude. Also, tillage inverted these observed effects of cropping sequence in two consecutive growing seasons, indicating a complex but reproducible interaction between rotation and tillage on the rhizosphere abundance. Amending conventionally managed sweet corn plots with dairy manure compost improved plant health and also increased the incidence of root colonization when compared to non-amended plots. Soil pH was negatively correlated to rhizosphere abundance of pseudomonads in no-till and non-amended soils, with the exception of the continuous corn treatments. Chemical seed treatments intended to control fungal pathogens and insect pests on corn also led to more abundant populations of pseudomonads in different tilled soils.

Additional work on plant diseases use rice oligo arrays to rapidly and efficiently classify defense mutants in rice. Ten carefully selected mutant lines that exhibit altered defense responses to fungal (*Magnaporthe grisea*) and bacterial blight (*Xanthamonas oryzae pv. oryzae*, Xoo) pathogens are selected to profile the gene expression before and after infections. So far, 156 hybridizations have been performed and 144 had good hybridization quality. Twenty-six genes show at least a two-fold induction in the enhanced resistant transgenic line NH1ox and at least two-fold reduction in the enhanced susceptible transgenic line NRR1ox. A total of 32 activation tagging candidate lines were found for 22 genes. Among them, 13 lines showed enhanced resistance phenotypes to Xoo race 6. RT-PCR analysis confirmed that seven genes were activated in the mutants. Most importantly, these seven genes encode defense related proteins that are involved in basal resistance to pathogens.

Also developed was a significantly improved transient expression method that can be used for rapidly screening and characterizing candidate genes that are involved in defense signaling pathways. High-level co-expression of multiple genes and efficient suppression of exogenous and endogenous genes have been observed in the transformed rice protoplasts. Furthermore, a protoplast-based bimolecular fluorescence complementation (BiFC) system for the detection of protein-protein interactions in living rice cells has been optimized as well as development of a hybridized genomic DNA from rice deletion mutants generated by gamma ray and fast neutron.

b. **Impact** - Because of their reduced toxicity and their potential to provide increased protection, biological seed treatments have long been considered a desirable alternative to chemicals for suppressing plant diseases in various crops. While many biopesticide products are currently available, few are labeled for use as seed treatments. OARDC scientists identified and developed novel, safe, and

cost-effective bacterial inoculants that can be used to protect and increase the profitability of Ohio's major field crops.

One group of such beneficial bacteria belongs to the species *Bacillus subtilis*. Despite their commercial availability, relatively little is known about the molecular basis for disease suppression by *Bacillus subtilis*. In this study, several genetic markers associated with beneficial activities of *B. subtilis* inoculant strains were identified using a comparative genomics approach. Additionally, three newly discovered strains that contained these markers were generally more effective at inhibiting the growth of plant pathogens (i.e. Rhizoctonia *solani* and *Pythium ultimum*) than other *Bacillus* isolates that lacked the markers. Thus, these markers can be used to identify new isolates with good biocontrol activity on different crops. Additionally, these genetic markers can be used to further define the diversity, ecology, and biocontrol activities of *B. subtilis.*

On another front in plant health, OARDC researchers are determining how plants recognize pathogens as a means of improving crop plants used by humans. The genetics of interactions are guiding traditional efforts by breeders. Understanding the molecular mechanisms also permits non-breeding efforts, such as transgenic plants with altered disease resistance traits or production of chemicals that affect interactions between pathogen and plant proteins. OARDC scientists targeted a host protein relating to resistance responses against virulence proteins. The researchers discovered that targeting of this host protein causes each virulence protein to weakly activate the R-protein normally activated by the other. Thus, a previously unknown cross-specificity exists between virulence proteins and R-proteins. The identification of this phenomenon permits the study the molecular mechanism underlying activation of these two R-proteins. Results from this work translate to tomatoes, which is of great importance to Ohio growers. The greatest impacts of this work will go beyond tomatoes because it addresses very basic questions that are fundamental to understanding the interaction between a variety of parasites and their hosts, both plant and human.

OARDC's work on the importance of individual genes in soybean resistance has revealed that multiple genes work together in different ways in different soybean lines. This greatly enhances the effectiveness of resistance by allowing for more careful selection of the best combinations of soybean line breeding. Also, through screening a wide range of plant species, OARDC scientists have discovered several new plant natural products that "prime" soybean defense responses to pathogen attack. Defense priming is a potentially very effective way to protect crop plants. It does not activate defense reactions, per se, but causes the plant to react more strongly to the presence of the pathogen upon attack. Due to intellectual property issues of the chemical identity, disclosure is premature.

Rice blast, a pathogen, is well documented as the leading cause of yield loss of rice worldwide. All parts of the plant, including roots, are subject to attack, but an infection that occurs immediately below the panicle is most destructive, virtually ensuring a complete loss of rice. *M. grisea* is known for its high variability in field conditions that causes frequent loss of host resistance. The

annual yield loss due to the disease is about $5.0 billion dollars worldwide. Cloning and characterization of the Pi2, Pi9, and Piz-t genes at the Center provide new insights about the molecular mechanism underlying their broad-spectrum resistance. Markers linked to the genes are now available for marker-aided selection in rice breeding programs.

Knowledge of the distribution and activities of plant pathogens and their antagonists are prerequisite for the development of workable disease management strategies that rely on biological control. And, understanding complex dynamics of soil microbial community structure will allow us to more accurately predict and quantify the effects of different farm management practices on productivity and sustainability. Current research indicates that the abundance of DAPG-producing *Pseudomonas spp.* is positively correlated with crop stand and yields, and that farm management can affect such relationships in predictable ways. OARDC scientists demonstrated that farming practices can alter the relative abundance and incidence of pseudomonads in the rhizosphere and that practices that reduce root disease severity (i.e. rotation, tillage, and chemical seed treatment) are not universally linked to increased root colonization by DAPG-producers. Additionally, the Center developed and tested a low-cost seed treatment strategy that allows organic and conventional farmers to treat their own seed prior to planting. Also on conventionally managed land, the yield enhancement is comparable to that conferred by conventional seed treatment chemicals. These results offer organic farmers new options for protecting field crops against seedling diseases.

OARDC has contributed to the understanding of the activation and networking of the defense signaling pathways in plants. Scientists at the Center are using microarray technique to rapidly profile defense mutant lines that exhibit altered defense responses to rice pathogens. From hybridizations, many commonly or uniquely regulated genes in the mutants were identified. A newly developed protoplast-based method has great potential as an alternative to the yeast two-hybrid system for large-scale detection of protein-protein interactions in living plant cells. The application of the above newly developed method will accelerate large-scale functional analysis of the completely sequenced genome of rice and other important crops including corn, wheat, barley, and sorghum to increase knowledge for crop improvement. Further functional analysis of these genes will provide insights into the networking of defense pathways in rice. The project is extended via an OARDC-sponsored *Classroom Activities in Plant Biotechnology*, and reached out to over 700 Ohio school students in 2005 and 2006.

c. **Source of Federal Funds** - Hatch

d. **Scope of Impact** – Multi-State

8. **Key Theme: Economic Competitiveness**

(Reference OSU Plan of Work Research Program 1H: Economic Competitiveness)

a. **Description of Activity** - Germplasm is a key economic asset. The Ornamental Plant Germplasm Center (OPGC) has been established and is at full level operations on the Columbus Ohio campus as a joint project between OSU and the USDA. The primary mission of the center is to conserve and nurture the world wealth of herbaceous ornamental plant diversity. The center is one of 24 germplasm repositories in the National Plant Germplasm System. OSU established the OPGC with the goal of building the OPGC into the world's leading herbaceous ornamental plant gene bank. As an extension of this goal, the center works not only on gene banking, but also on research, development, education, and training.

The possession and presence of a germplasm repository provides Ohio with an important resource for future research and development initiatives. Through biotechnology techniques, the genes and genetic traits of one species can now cross species boundaries to impart beneficial characteristics in completely unrelated species. The possession of germplasm thus forms a basic building block upon which scientific progress and discoveries may be made.

b. **Impact -** The OPGC not only conserves and preserves germplasm, but it also serves as a part of a system designed to promote industry-oriented collaboration and enhance the commercial application of germplasm resources and knowledge. To this end, OPGC has built a network of partners and collaborators from academe, the horticultural industry, biotechnology industry, botanical gardens and arboreta, and the USDA.

Through the preservation of germplasm and the controlled dissemination of valuable germplasm for research and development purposes, the OPGC is assisting academic and industrial scientists in the development of future crops that are resistant to pests and disease; more efficient in their use of nutrients and environmental resources; and more appealing to the marketplace because of improved color, texture, taste, smell, or nutrition characteristics. The germplasm is also proving valuable in applications outside of agriculture and horticulture—presenting opportunities in the discovery of medicines, chemical products, and other commercializable resources.

c. **Source of Federal Funds** – Hatch

d. **Scope of Impact**- State Specific

9. Key Theme: Plant and Animal Biotechnology

(Reference OSU Plan of Work Research Program 1I: Plant and Animal Biotechnology)

a. **Description of Activity** - Ohio ranks third in the U.S. for the farm value of both fresh-market and processing tomatoes with a combined farm value that exceeds $85 million. There is a need to bridge a gap in the availability of DNA-based markers for genetic analysis within breeding populations of tomato. The lack of genetic markers that detect differences between elite breeding lines has prevented detailed study of traits of agricultural importance. Most academic studies in tomato have used wide crosses between weedy relatives and cultivated varieties.

This approach maximizes genetic variation and has lead to the discovery of new genes, but it has also left a void in knowledge of and ability to manipulate many traits of agricultural importance. For this reason, the application of marker-assisted selection (MAS) to tomato improvement is primarily for the introduction of traits from poorly adapted plant material, and has not been utilized to more fully compliment traditional plant breeding.

Using data-mining techniques, the research targeted variable portions of genes, and then exploited these regions of variation for genetic mapping of traits important to Ohio growers and processors. The approach leveraged emerging data from genome sequencing projects, laboratory techniques such as those used in forensics for DNA fingerprinting, and created a database to facilitate tomato breeding.

Corn and soybeans are other key crops in Ohio. In Ohio and across the nation, the percentage of the acreage of corn and soybeans that is genetically modified continues to climb. In 2005, approximately 87% of soybeans and 35% of corn were genetically modified. To produce genetically engineered plants, genes are initially selected that have the potential to show benefit to the farmer, consumer, and environment and then evaluated for optimal performance. OARDC scientists have developed and refined a unique robotic system that allows for more efficient gene evaluation leading to more predictable and consistent gene expression in genetically engineered plants.

During this research, four different fragments of DNA from soybean were identified as "promoters". Promoters are pieces of DNA, in front of the main body of the gene, that determine where and when the gene is turned on. The project identified two strong promoters that direct gene expression in all tissues, as well as one root promoter and a promoter that may be turned on during heat stress. These promoters can now be used to direct the function of other genes in genetically engineered soybean. Prior to this research, less than five promoters had been identified in soybean. OARDC researchers have submitted an invention disclosure to the OSU Office of Technology Licensing and are seeking patent protection and licensing on this new technology.

b. **Impact -** OARDC scientists have identified over 400 molecular markers for tomato breeding applications with 180 of these are currently available to stakeholders and fellow scientists in an on-line database <http://tomatomap.net>. These markers have been applied to the development of new disease resistant varieties and are currently being used by stakeholders to improve color and color uniformity.

OARDC scientists are currently pursuing even more efficient approaches for the discovery of new genetic markers, genes of agricultural value, and integrating technologies. One such approach uses a gene chip to identify genetic differences. The integration of genetic data and trait data selected is being accomplished in complex populations that are expected to yield new tomato varieties for Ohio growers. Currently, several candidate genes are being assessed which explain variation between lineages relative to environmental adaptation, market class, fruit morphology, color, and nutritional quality. These analyses are laying a solid foundation for linking specific alleles to traits. While not yet at the impact level, these data do inform basic scientific research worldwide.

In corn and soybean research, results are starting to generate hybrid synthetic promoters that take components of different promoters and fuse them together for evaluation. An OARDC developed automated robotics system allows rapid evaluation of the different promoters by following or tracking gene expression in different tissues, over time. Lastly, fragments of DNA that appear to stabilize or normalize gene expression have been characterized using this system. Although the function of these DNA fragments have been suggested, the system now allows for the characterization of them in a way not previously available.

c. Source of Federal Funds – Hatch

d. Scope of Impact- State Specific

Goal 2. A Safe and Secure Food and Fiber System

Executive Summary

Food safety is a national priority because failure to protect our food supply from natural outbreaks of diseases and food poisoning threatens consumer health as well as export markets. Granted there is also the possibility of terrorist's threats to our food supply but in terms of risk analysis, this external threat would seem to be small. Still, one incident could cause such public fear that it could create an economic disaster for segments of the food/agricultural industry. It is often argued that food recalls are proof that the surveillance system for the protection of our food supply is working. However, the increase in communications and the 24/7 news outlets provides greater publicity to any event than it warrants which could be a major part of the public perception that our food supply is becoming increasingly dangerous.

Safe food handling is a targeted issue and includes: Promote food safety across the food chain; consumer education for safe food handling; certificate training for food handlers; and food safety education for growers, producers, distributors, retailers, and food service workers. At the same time that food safety is an issue, consumers demand and will pay for greater convenience. The challenge is to produce food which is nutritious and tasty but which can be processed and distributed without contamination, either accidentally or deliberately, and is handled safely as it is prepared by and for consumers.

At the same time that food safety is an issue, consumers demand and will pay for greater convenience. The challenge is to produce food which is nutritious and tasty but which can be processed and distributed without contamination, either accidentally or deliberately. Consumers' lifestyles, hence their eating habits, are constantly changing. These changes bring about increased demand for high quality, value added, and convenient foods. This requires that production of food ingredients, which are as nutritious as non-processed counterparts and are not subject to contamination with harmful microorganisms during production and shipment.

Food safety, both pre- and post- harvest, is of state, national, and international concern. Whether the threat is a terrorist-sponsored or from naturally occurring organisms, research to ensure the protection of all sources of our food and the delivery system itself is critical for the security of all citizens. Likewise research programs into the functionality of foods – flavor, quality, utility,

novel foods, consumer acceptance, etc.- must also be incorporated into food systems research if we are to account for the multitude of variables within food systems modeling.

At state, national, and international levels, food safety, both pre- and post- harvest, is a concern. Regardless the source of the concern, natural or human induced, research to ensure the protection of all sources of our food and the delivery system itself are critical for the security of all citizens. Also functionality of foods - flavor, quality, utility, novel foods, consumer acceptance, and similar - is a major element in food systems research if we are to account for the multitude of variables within food systems modeling.

Within Goal 2 protecting against mastitis, salmonella and other egg-relate pathogens, food spoilage, and bacteria in ready-to-eat salads, as well as the role of powered coatings in enhancing and protecting foods, are discussed. Functionality of foods to aid in prevention of heart diseases, as well as other diseases, is also discussed within.

Smith-Lever Fund expenditures for Goal 2: $1,141,100 EXTENSION FTE's: 16.9
Hatch expenditures for Goal 2: $155,642 OARDC FTE: 1.5

Goal 2 Key Themes

1. Key Theme: Food Safety

(Reference OSU Plan of Work Extension Program 2Ae: Pre-Harvest Food Safety)

a. **Description of Activity** - The Ohio Department of Agriculture mandates all youth who exhibit food producing animals to attend quality assurance training annually. This yearly event is the result of drug residues in junior fair animal carcasses and at the urging of meat processors in the state. To answer the Ohio Department of Agriculture mandate County Extension Professionals with the cooperation of Ag Educators and Ag Societies provide educational quality assurance programs developed with the guidance of State Extension Specialists that assure packers and consumers of a safe wholesome product.

b. **Impact** - More than 50,000 youth and adult junior fair food animal producers received quality assurance training to assist them in meeting compliance standards being implemented by respective food animal processing industries. With this in mind State Extension Specialists and Extension Educators developed and introduced the New "Youth Food Animal Quality Assurance Curriculum Guide" at the 2005 QA Extension Educators in-service. The end result were QA programs that will be more consistent providing educators the tools to develop a program that will cater to a number of learning styles including both lecture and hands on experiential learning. The full impact of this curriculum was determined during the 2006 QA training year, as Extension Educators, Ag Educators and Ag Societies had a full 12 months to implement the new curriculum. Several counties reported having no livestock quality assurance issues associated with their junior fair livestock sales in 2005 and 2006. With the New curriculum guide with one year in use and the increased rigor of the information youth are exposed to the

number of counties with a clean record for violations should continue to rise in 2007 as it did in during the inaugural year in 2006. Examples of QA programming impact across the state include:

- Ross County: 43 adults received QA training which included a three year certification by National Pork Board. Adults completed evaluation forms in which the instructor received an average rating of 4.81 out of 5.00 on her teaching. These certified volunteers taught Quality Assurance to 1300 youth. These youth reviewed the components of the 10 Good Production Practices, watch a video on ethics, completed an activity on proper care of animals and another activity that including learning about drug residue and withdrawal time to teach them how to properly care for their animals so that they will provide a safe, wholesome product for consumers.
- Muskingham County: 525 youth and another 400 adults participated in one of three county level quality assurance workshops for livestock, under the direction of 25 adult and teen volunteers and extension staff. An additional 300 youth participated in QA training at the club level under the direction of club advisors or at specie clinics such as poultry and rabbits. A four question "quiz" was administered at the conclusion of the county trainings that indicated knowledge gained in more than one area of production practices for all participants.
- Washington County: Four Quality Assurance Trainings, including three clinics, educated 367 4-H/FFA members and 378 parents/guardians in being a responsible and productive link in the chain of food production, animal health and welfare, veterinary-client-patient-relationship, ethical handling of market livestock animals, and the importance of nutrition in raising market livestock projects. Quality assurance sessions are serving to motivate youth to better understanding and skill in market livestock projects and food production
- Delaware County: Four hundred and seventeen 4-H and FFA youth learned livestock management practices relating to quality assurance, with 126 of those youth earning certification through the National Pork Producers Council youth Pork Quality Assurance program. Participants worked through a hands-on simulated pen building activity which caused participants to take a second look at space requirements for their animals. Specific sheep and goat QA sessions addressed USDA Scrapies regulations and at the 2006 Delaware County Fair, problems with Scrapies ID compliance.

c. **Source of Federal Funds** – Smith-Lever 3b&c

d. **Scope of Impact** – State Specific

2. **Key Theme: Food Safety**

(Reference OSU Plan of Work Research Program 2Ar: Pre-Harvest Food Safety)

a. **Description of Activity** - Mastitis resistance in dairy food safety is a major concern of OARDC scientists and a long established program at the Center. The occurrence, phenotypic and genotypic diversity, both within vitro and in vivo growth response of *Enterococcus spp.* isolated from bovine origin, are being used

in a vitro study that has examined the growth of enterococcal isolates in mammary secretion from various stages of lactation. The results suggest the source of enterococcal isolates and the bacterial species significantly contribute to the ability of that organism to adapt to mammary secretion from various stages of lactation. An in vivo study of the physiologic effects of 4 *E. faecium* isolates in the bovine mammary gland in early and late lactation was benefical. Genotypic evaluation was characterized using pulsed-field gel electrophoresis analysis of SmaI restriction patterns. These data suggest enterococci of bovine origin are genetically diverse while isolates of various sources appear to cluster together.

b. **Impact** - In a study of mastitis resistance to enhance dairy food safety antibiogram profiles and pulse field electrophoretic, DNA dentograms were developed and validated to define the most likely routes of enterococcal transmission between humans and dairy cows. Critical control points and procedures to minimize transfer to humans and cows have been further defined and reported. The use of FDA approved antibiotics for therapy of bovine mastitis was found not to be linked to vertical transmission of resistance.

c. **Source of Federal Funds** - Hatch

d. **Scope of Impact** – Multi-State

3. Key Theme: Food Safety Training for Food Establishments

(Reference OSU Plan of Work Extension Program 2Be: Post-Harvest Food Safety)

a. **Description of Activities** - Ohio Food Code requires that a "person-in-charge" who is knowledgeable of food safety to be present at all times in licensed food establishments. Successful completion of the ServSafe manager-training program and a passing score on the national certification examination qualifies an individual to meet this regulatory requirement for the respective business. Sixteen hours of instruction are required to meet certification. The course is certified by the National and Ohio Restaurant Associations and the Ohio Department of Health. Ohio State University Extension has 26 qualified instructors who are recognized by the Ohio Health Department as providers. Another version of the same training is aimed at employees who desire food safety knowledge, but who are not serving as "person-in-charge." This is a 6-hour training course and is provided by the same 26 qualified instructors.

b. **Impact** - This program allows food establishments to meet compliance requirements for local and state inspection. In 2006 alone, there were 336 participants in both employee and manager trainings. For the managers' training program, the national certification examination is required. The passing rate for all participants who attended extension-sponsored programs was 89%. The average score on the exam was 85%. This program allows food establishments to meet compliance requirements for local and state inspection. Managers who attend this course do so for the purpose of training their own employees, thus this program has a projected multiplier effect of 500% (i.e. for every one participant trained, five additional employees will receive training within the business).

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** – State specific

4. Key Theme: Food Safety – Volunteer Quantity Cooks

(Reference OSU Plan of Work Extension Program 2Be: Post-Harvest Food Safety)

a. **Description of Activities -** Churches, civic organizations, 4-H clubs – all of these groups sponsor events where food is prepared and served to large numbers of people. The volunteers who prepare that food may only have household food safety information, but they are operating in a public situation where members of groups at high-risk for foodborne illnesses may be dining. Volunteer quantity cooks learn how to protect their clients through an extension sponsored and taught program to train them in safe food handling procedures.

b. **Impact -** The workshops held this year benefit each person who ate the food prepared; thus, this program represents a train-the-trainer program that will impact many more than those who actually attend the workshops. There were over 40 Occasional Quantity Cook workshops held in 2006, with over 380 participants; including 4-H advisors, 4-H volunteers, Extension personnel, churches, Head Start Volunteers, and Master Gardener Volunteers.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** – State specific

5. Key Theme: Food Safety Programming

(Reference OSU Plan of Work Extension Program 2Be: Post-Harvest Food Safety)

a. **Description of Activities** - Ohio State University Extension serves the local clientele with a variety of activities aimed at improving the safety of food prepared and eaten in the home. County educators are a reservoir of information on topics like safe food storage and preservation. They provide information to Ohio residents about potentially tainted or spoiled foods, procedures on how to ensure safe food preparation, and food safety aimed at special groups like senior citizens or youth. Workshops, health fairs, in-store demonstrations, media, and face-to-face conversation are methods used to deliver food safety information to clientele in 2005.

Foodborne illnesses adversely affect the health of Ohio citizens and are costly to the State's economy. Health care costs associated with the care of foodborne illnesses are increasing. The Ohio Department of Health compiles data on cases for foodborne illness, making it possible to calculate the economic impact of foodborne illness in Ohio for selected pathogens. Reported cases are low indicators of actual disease, so estimates of actual cases more accurately reflect health care costs. The foodborne diseases with the greatest incidence in Ohio during 2003 were Campylobacteriosis (1265), and Salmonellosis (1326). Using per case cost factors available from the Economic Research Service (USDA), it is possible to calculate economic impact of foodborne illness in Ohio

for selected pathogens. The estimated health care cost of Campylobacteriosis during 2003 was $29,370,770 and $90,144,132 for Salmonellosis. Food safety education is effective when messages are targeted toward changing behaviors that have the greatest impact on preventing foodborne illness.

b. **Impact -** The continued emphasis on food safety in all types of programs will ensure that Ohioans will continue to enjoy safe food. A total of 15,116 direct contacts for food safety were made during 2006. Nearly 50,000 copies of materials pertaining to food safety were distributed, and an estimated 355 volunteers contributed 1,592 hours towards food safety programs. Ohio offers three specific food safety programs: ServSafe Manager training, ServSafe employee trainings and Occasional Quantity Cooks.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** – State Specific

6. Key Theme: Post-Harvest Food Safety

(Reference OSU Plan of Work Research Program 2Br: Post-Harvest Food Safety)

a. **Description of Activities -** *Listeria monocytogenes,* a bacteria, is a major problem in the ready to eat food market because it is a pathogen that is found everywhere. *L. monocytogenes* has been responsible for many food related illnesses and deaths. Because of this, the USDA has set a zero tolerance limit for *L. monocytogenes* in foods, especially those containing egg products that will be eaten without cooking or will only be warmed.

When lowering the pH of raw eggs to below the minimum needed for growth of *L. monocytogenes* using lactic acid was found to produced the best results for lowering pH but still had a slight off flavor. Various combinations and masking agents were tested, but ultimately none were successful at covering the off flavors produced at the necessary pH to inhibit growth of *L. monocytogenes*.

The next approach was to develop a cooked, ready to eat product that could be distributed frozen, and then microwaved without having to be thawed. The best combination was to freeze before packaging in a still air freezer. This resulted in no package ice formation during storage. Most importantly, this approach produces an acceptable product but is limited to frozen distribution.

In additional egg-related research, salmonella-free market shell eggs are within reach. The US Egg Safety Action Plan calls for complete eradication of salmonella from market shell eggs during the next decade. Salmonella causes a serious food-transmitted disease, and incidence of salmonellosis is the highest among food borne diseases in the US. Ohio is the second in the nation in egg production, and the national action plan has a major impact on Ohio egg producer and processors, and on the State's economy. OARDC scientists are collaborating with a consortium of Ohio egg producers and equipment manufacturers to optimize an ozone-based technology for eradication of salmonella in fresh eggs. A newly developed ozone generator has the ability to optimize the process for industrial scale-up. Discussions are in progress with a potential manufacturer of commercial units. This manufacturer met with the Eggtech Ltd. Partners, the

OARDC investigators, and CIFT to plan the next phase of commercialization. The focus is now on a commercial scale design of equipment that validates an egg decontamination process that can be used by the egg industry.

The contamination by pathogens or spoilage microorganisms in foods is also an important health threat and causes significant financial loss to both the society and food industry. Using cutting-edge technologies, OARDC has developed a rapid detection method to improve food safety, quality, and security. Biofilms formed by microorganisms attached to foods are important sources of secondary contamination, key mechanisms for pathogenic and spoilage organisms persistent in the environment, and major threats to human health. Understanding the molecular events involved in biofilm formation led to the development of effective strategies to control and remove biofilms.

The rapid emergence of antibiotic resistant (ART) pathogens is also a major threat to public health. Understanding the main pathways leading to the evolution and transmission of ART bacteria is essential to combat this problem. OARDC is evaluating the potential role of food chain as an important avenue in the evolution and transmission of ART bacteria to human, besides the clinical settings. Using the rapid detection platform established by Center scientists, *Listeri*a monocytogenes expression in conditions simulate processing environment by real-time RT-PCR has been successfully assessed. Both temperature and acids found in food processing and storage environment can significantly affect *L. monocytogenes* virulence gene expression.

Further inquiry found that 100% of the ready-to-eat salad samples (both retail and from fast-food-chain restaurants) are contaminated with antibiotic resistant bacteria, and the resistance genes from the salad isolates are transmissible to and functional in human residential bacterium. These data strongly supported the notion that the food chain has emerged as an important avenue in transmitting the antibiotic resistant bacteria and resistance encoding genes to human.

In another food safety study, it was demonstrated that improvement in color and shelf life of food was achieved by promoting enhanced food coating evenness by charging of the coating powder. The smaller the size of the powder, the greater the charge to mass ratio and the greater the improved final color development. Electrostatic and nonelectrostatic coatings were compared to determine the improvement between corona and triboelectric charging systems. Electrostatics improved transfer efficiency up to 27%, adhesion up to 40%, and reduced dust up to 99% over nonelectrostatic coating. Particle size and composition significantly affected the improvement produced by each charging method. As particle size increased, nonelectrostatic transferefficiency and adhesion increased, while dust decreased.

b. **Impact -** Eliminating *Listeria monocytogene* in frozen foods, particularly those with egg products, is a major step forward for the industry. The best strategy found was to freeze before packaging in a still air freezer. This resulted in no package ice formation during storage. This approach produces an acceptable frozen product. The study also paves the way for OARDC and industrial partners to explore additional antimicrobials for adding to a safe national food supply.

The US Egg Safety Action Plan calls for salmonella free eggs by the year

2010. This goal was set when there was no existing technology to achieve it. Fortunately, several innovations at OARDC and other laboratories have made this goal a real possibility. An Ohio partnership engages three major egg producers who see economic growth and job creation as we meet the national goal of salmonella free eggs and advance technologies that improve food safety. Now on a commercial scale, the partnership has created equipment necessary to validate an egg decontamination process that can be used by the egg industry.

OARDC inquiries have also revealed for the first time that our retail foods, including many ready-to-eat salads, generally considered "healthy" items, are heavily contaminated with antibiotic resistant bacteria and these bacteria are transmitted to human through daily food intake. Commensal organisms in the food chain not only can serve as a resistance gene reservoir but an enhancer for the transmitting of resistance genes. The results illustrated a potentially very important avenue in the dissemination of antibiotic resistance genes in the general public, and likely will have enormous impact on food safety and public health. Besides the contribution to scientific understanding, this research also has significant impact on food industry. In the US alone, this research affects the annual production of 20 million pounds of fermented dairy products business. Worldwide, the number is much larger. Its impact on the even larger fresh produce business is yet to be evaluated,

Food coating effectiveness is a major concern of the food industry. Electrostatic coating can be used to increases transfer efficiency of powder coating, which can save money for the food industry and promote food safety. When comparing the same amount of powder on each sample, electrostatically-coated samples show a greater color development or less mold growth than non-electrostatically coated samples, indicating that the functionality of the powder is also improved by electrostatic coating. The improvement in color and shelf life are the result of improvement in coating evenness due to the charging of the powder. Ectrostatic adhesion can last for several weeks, indicating that electrostatic adhesion is a significant part of the adhesion forces, and lasts long enough to be valuable. Additionally, liquid smoke was found to improve the color of microwaveable French fries without affecting French fry flavor or texture

c. Source of Federal Funds – Hatch

d. Scope of Impact – Multi-State

7. Key Theme: Functionality of Foods

(Reference OSU Plan of Work Research Program 2C: Functionality of Foods)

a. Description of Activities - Coronary heart disease is the leading cause of death in the United States; it afflicts as many as 12.9 million Americans and annually contributes to $129 billion in hospital costs (2000 statistics AHA 2003 Handbook). Ethnic and migrant studies indicate that a diet rich in soy foods such as tofu, soy nuts, and soymilk can reduce the risk of diseases common in the United States. Studies have suggested eating foods with proteins and isoflavones (naturally occurring plant chemical) that are commonly found in soybeans can

reduce the risk of heart disease by lowering cholesterol and improving antioxidant levels in the blood.

In spite of the popularity and efforts invested in soy research, there is a lack of information concerning how the body uses and breaks down isoflavones. One possibility may be related to differences in the way the soy is consumed. Specifically, a liquid soy drink may be very different than a solid food such as bread. The differences in their texture (matrix) may be important in influencing how the body uses and breaks down soy foods.

Additionally, work into uptake of carotenoid phytochemicals also contributes to reducing coronary heart disease. OARDC scientists continue to assess whether frequently consumed lipid-rich fruit can increase carotenoid absorption when consumed together with carotenoid-rich foods and if this increase in carotenoid absorption is comparable to the effect of adding equivalent amounts of fat or oil alone.

For example in a salsa study, lycopene and beta-carotene absorption increased significantly in subjects who consumed their meal with avocado. Considerable increases in lutein, alpha-carotene, and beta-carotene absorptions were also observed after the salad with the addition of avocado fruit or avocado oil.

b. **Impact -** Soy is an important functional food. An OARDC led metabolism study focused on different soy foods. Information obtained from personal interviews demonstrated that both the soy shake and bread were well accepted by the participants. Both foods had good compliance with the suggested study diet. The data collected from the urine samples after each of the soy foods were eaten showed that the metabolites (natural breakdown products from food) of natural soy plant chemicals were being excreted similarly. Furthermore, participants experienced a lowering of their total cholesterol and their triglycerides during their six-week participation. Their findings regarding consistencies and available knowledge about soy breakdown and its use in the human body further advance how we make our food more functional.

Further functional food research, in a carotenoid study, found that some fat is necessary in the diet to efficiently absorb fat-soluble nutrients such as carotenoids. Because most fruits and vegetables are low in fats, consuming some lipids within salads as dressings or from fat containing fruits like avocados is recommended. Most of the fruits and vegetables that contain high levels of the lipophilic carotenoids have low levels of fats, which may decrease their absorption. Therefore, this understanding of the ability of the body to uptake carotenoids when they are consumed with healthy sources of fat is critical.

c. **Source of Federal Funds** – Hatch

d. **Scope of Impact** – Multi-state

Goal 3. A Healthy, Well-nourished Population

Executive Summary

Dietary Guidance can be defined as the use of principles found in the Dietary Guidelines for

Americans to develop non-formal nutrition education series for youth and adults. Additionally, there are programs targeted to the elderly, and to individuals at risk for or having diabetes, focusing on their nutritional needs. These community-based nutrition education programs are offered at the local level by OSU Extension. The Dietary Guidelines for Americans provide a basis for healthy lifestyle choices. The Food Guide Pyramid is a pictorial and practical guide for educating consumers to use the Dietary Guidelines. OSU Extension professionals inform consumers of health risk factors (e.g., obesity, hypertension, etc.) and nutrition practices and encourage appropriate nutrition and lifestyle changes and promote reading labels on processed foods.

U.S. citizens, like other highly developed countries in the world, have an abundant, inexpensive food supply available to them. Food provides both pleasure and the nutrients necessary for health and survival. The goal is for all to be food secure, that is, access by all people at all times to enough food for an active, healthy life and at a minimum, includes: (1) the ready availability of nutritionally adequate and safe foods, and (2) the assured ability to acquire personally acceptable foods in a socially acceptable way. It is important to recognize that nutrient needs vary over the life cycle and research must be conducted to determine how age and gender influence nutrient needs. It is also important to recognize that the human body uses nutrients in chemical reactions within the body. Nutrition science plays an important role in reducing obesity, diabetes, cancer and heart diseases. The Ohio State University is one of a few institutions with a college of agriculture, a department of human nutrition science, and a medical college. Scientists from the many disciplines are researching together such agricultural products as tomatoes, soybeans, and raspberries to discover the chemical content and chemical reactions in hope of discovering chemicals that are effective as antioxidants and as anti-carcinogens. They are also researching behaviors that lead to healthy food choices.

A healthy, well-nourished population is dependent on the ability of people to obtain foods that will improve the over-all quality of their diets, and the quality of the food they eat. A healthy population also engages in other positive health practices, including physical activity, individual health monitoring, and safety practices that will reduce the risk of accidents and disease. OSU Extension professionals have been actively educating the people of Ohio regarding the importance of good health and nutrition practices. The professionals met with individuals and groups, in formal and non-formal teaching sessions, in workshops, committee meetings, health fairs, and walk-by exhibits. The result has been a change in 1) the way some individuals purchase, prepare and store food; 2) the level of interest in monitoring and improving health through screenings and exams; and 3) the ability of individuals to improve their personal practices to decrease health risk.

OARDC is invested in human nutrition and health research. With increasing numbers of retirees living longer, cancer and heart concerns, obesity, and similar demand that health and nutrition systems continue to be given a high priority. With each incremental gain in the improvement of health care and nutrition will come major positive impacts on society. Ongoing research at OARDC contributes to gains in improved nutrition and better understanding of the role of nutraceuticals. OSU Extension programs carry these science-based findings to the citizens of Ohio. Discussed within are a low glycemic index (GI) food and food supplement, phytochemicals and health, and the “crop to clinic” concept, among other health related research.

Smith-Lever fund expenditures for Goal 3: $1,668,938 EXTENSION FTE's: 24.2
Hatch expenditure for Goal 3: $30,750 OARDC FTE: 0.2

Goal 3 Key Themes

1. Key Theme: Ohio Food Stamp Nutrition Education (aka - Ohio Family Nutrition Program)

(Reference OSU Plan of Work Extension Program 3Ae: Human Nutrition/Health)

a. Description of Activity - The FY2006 Ohio Family Nutrition Program (FNP) received $2,211,066 from the United States Department of Agriculture through Ohio Department of Job and Family Services to conduct nutrition education in 67 county units across the state of Ohio. The goal of the Ohio Family Nutrition Program is to improve the likelihood that Food Stamp Program (FSP) participants and applicants will make healthy food choices within a limited budget and choose active lifestyles consistent with the current Dietary Guidelines for Americans and the MyPyramid Food Guidance System.

The educational methods included: face to face delivery through group meetings, demonstrations, hands on opportunities for skill development, displays at health fairs and other community events targeting the food stamp audience, and newsletters. FNP programs collaborate with other organizations that target the same audience. Programs are presented in locations that are near to participants' homes, at times convenient to participants, and in community sites that Food Stamp Program participants frequent.

The goal for the FNP Program Assistant is to teach three or more interventions (series) planned for a consistent group of 2 or more individuals, lasting a minimum of 20 minutes per intervention, offered on different days, and including an evaluation component. Preferably the subject content of each class in the series is related to the same objective. The teaching objective for a series may be Nutrition, Food Safety, Thrifty Food Shopping, or General (includes all three objectives). Each program includes a component related to Food Security. In some cases a series of classes may be impossible, thus a single lesson is the alternative. A single lesson is an intervention planned for 2 or more individuals, targeting one of the above FNP objectives, lasting at least 20 minutes and including an evaluation component.

b. Impact - In FY2006 the Ohio FNP program reached 66,237 direct contacts and 244,917 indirect contacts. Participants were a part of 5,187 nutrition interventions; 1,270 food safety interventions; and 1,625 thrifty food shopping interventions. A total of 53,813 participants indicated they learned new information and 50,397reported they planned to make changes in their food related behaviors. Thirty six percent (36%) of the participants completing an end of class survey indicating some degree of food insecurity. Individuals reported the types of food assistance they were receiving: 30.8% reported using food stamps, 18% reported using WIC, 12.4% had family members utilizing child

nutrition programs, 4.4% reported using commodity foods, 13.8% utilized local food pantries, 4% utilized soup kitchens, and 20.5% utilized senior meal sites.

Individuals participating in a series of classes were asked to complete a 5 point Likert scale retrospective survey at the last class of the program. The Likert scale retrospective survey is an evaluation instrument designed to gather outcome data for each FNP objective. The mean scores for the pre/post test for each evaluation question for FY2006 follow (each question is listed with the mean score before the program followed by the mean score after the program). Each question was statistically significant.

General (n= 1253)

- I use the "Nutrition Facts" on the food label to make food choices. (2.91, 3.74)
- I shop using a grocery list. (3.38, 3.85)
- I eat at least 2 cups of vegetables each day. (3.06, 3.59)
- I eat at least 1 ½ cups of fruits each day. (3.08, 3.61)
- I wash my hands with soap and water before preparing the food. (4.45, 4.64)
- I run out of food before the end of the month. (2.38, 2.37)
- I use the Food Guide Pyramid to select a variety of foods. (2.41, 3.22)
- I use a thermometer to check if foods were fully cooked. (2.04, 2.80)
- I am physically active (Walking, gardening, sweeping, etc.). (3.64, 3.98)

Nutrition (n=2920)

- I use the "Nutrition Facts" on the food label to make food choices. (2.95, 3.66)
- I use the Food Guide Pyramid to select a variety of foods. (2.54, 3.28)
- I eat at least 2 cups of vegetables each day. (3.02, 3.55)
- I eat at least 1 ½ cups of fruits each day. (3.04, 3.57)
- I am physically active (Walking, gardening, sweeping, etc.). (3.43, 3.77)

Food Safety (n=787)

- I wash my hands with soap and water before preparing the food. (4.33, 4.68)
- I use a thermometer to check if foods were fully cooked. (2.09, 3.31)
- I wash knives and cutting surfaces with hot, soapy water after preparing meat. (4.31, 4.59)
- I leave meat or leftovers like a casserole at room temperature for more than two hours. (2.22, 1.9)

Thrifty Food Shopping (n=673)

- I plan meals ahead of time. (3.08, 3.68)
- I use the MyPyramid Food Guidance System to select a variety of foods for my family. (2.36, 3.25)
- I compare prices before buying food. (3.4, 3.86)
- I shop using a grocery list. (3.33, 3.83)
- I run out of food before the end of the month. (2.38, 2.27)

c. Source of Federal Funds - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

2. Key Theme: Summer Food Service Program and Ohio Food Stamp Nutrition Education (FSNE)

(Reference OSU Plan of Work Extension Program 3Ae: Human Nutrition/Health)

a. **Description of Activity** - The goal of food stamp nutrition education is to provide educational programs that increase, within a limited budget, the likelihood of food stamp program (FSP) participants making healthy food choices and choosing active lifestyles consistent with the most recent advice reflected in the Dietary Guidelines for Americans and the MyPyramid Food Guidance System. FNSE works with the FSP participants to ensure they are able to acquire the food they need in socially acceptable ways. An example of this effort is to increase participants' knowledge and use of other food assistance programs.

The Ohio FSNE program, known as the Ohio Family Nutrition Program (FNP) partnered with the Summer Food Service Program, a USDA Food and Nutrition Service food assistance program, to help families maintain their food security throughout the summer months. The Summer Food Service Program provides free, nutritious meals to school-aged children in low-income areas during school vacations. Locally, approved sponsors operate the program. The sponsors receive reimbursement for the meals served and for operating costs. Sponsors may be schools, units of local government, public or nonprofit private residential summer camps, and other nonprofit private organizations. An approved site is in a community in which 50 or more percent of the population is living in poverty. Any child may receive a free meal at an approved open site without the need to apply. In FY06 ten counties participated: Guernsey, Huron, Logan, Lorain, Lucas, Marion, Ross, Shelby, Van Wert and Washington.

b. **Impact** – During the 8-9 weeks of the school summer break 10,876 children from 1 year to 18 years of age in 10 different Ohio counties participated in nutrition education activities conducted by the FNP and its Program Assistant or a paraprofessional contracted to teach. The program included 367 interactive, hands-on educational interventions. The primary topic discussed was nutrition and the targeted messages for maintaining a healthy lifestyle: eat a variety of foods, eat whole grains, eat more fruits and vegetables, increase physical activity, eat breakfast everyday, eat healthful snacks, read nutrition labels to make food choices, and eat low fat dairy foods. Each lesson included a parent component to extend the messages taught in the class to the child's home.

This resulted in 5,965 indirect contacts with the child's parent or guardian primarily in the format of a newsletter. Curriculum for a variety of age groups was provided to each participating county. Depending on the location of the intervention site and the needs of the children, lessons, activities and food demonstrations were provided. Site locations included schools, nonprofit agencies buildings, faith based agencies, city or community parks, and parking lots where the lunches would be dropped off by the sponsor. In some counties the FNP PA partnered with the 4-H program to bring additional activities to the

children. In other counties older children volunteered to help the younger children with the activities. Sometimes parents volunteered to help complete the tasks. A total of 644 individuals were reported to have volunteered their time in some capacity to help the program be a success.

At the end of the program sponsors were contacted to provide feedback as to the success of the efforts of the FNP program. All indicated they felt the program was a great success and of benefit to the children. They reported that the children really looked forward to the days when there were additional activities. Teachers reported that the children were able to stay on task better and were better prepared to begin the school year. Other sponsors felt the FNP program was very successful in engaging the children in the nutrition activities. Other responses included: looking forward to the program next year; being very willing to continue writing letters of support; and hoping we can continue working with their after school programs.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

3. Key Theme: Nutrition Education – Food resource management

(Reference OSU Plan of Work Extension Program 3Ae: Human Nutrition/Health)

a. **Description of Activity –** Expanded Food and Nutrition Education Program's (EFNEP) program assistants used a variety of means to share information about food resource management. People were reached through media outlets, such as radio, newspapers, newsletters, and through direct contact in programs on a weekly or monthly basis. Objectives of the programs and media messages involved use of food resource management and shopping behaviors that improve personal and family food supply; how to save money while shopping for food; planning spending for food; make wise choices about how food is acquired, how often food is purchased, and types of food purchased; use comparative pricing of food; and use recommended meal planning and preparation practices.

b. **Impact -** Thirty seven program assistants (25.5 FTE) working with the adult phase of the Expanded Food and Nutrition Education Program reached 5,502 parents of young children between October 1, 2005 and September 30, 2006. Homemakers who graduated from the series of classes taught by the Expanded Food and Nutrition Education Program's Program Assistants showed change in the ability to manage food resources and practice food safety recommendations, and improved their nutrition knowledge and practices. Seventy four percent (74%) of graduated homemakers showed a positive behavior change in one or more food resource management practices taught to them(meal planning, price comparisons, strategies for extending the food supply, or use of a grocery list to be a wise shopper). Seventy nine (79) percent of homemakers that participated in EFNEP showed improvement in one or more nutrition practices (planning meals in advance, thinking about healthy food choices, preparing foods without adding salt, using food labels, and children eating breakfast). Fifty eight (58) percent of homemakers that participated in EFNEP showed improvement in one or more of the food safety practices (not allowing meat and dairy foods to sit out for more

than 2 hours, not thawing foods at room T).

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

4. Key Theme: Human Nutrition Targeting Ohio Youth

(Reference OSU Plan of Work Extension Program 3Ae: Human Nutrition/Health)

a. **Description of Activity –** "Jump into Foods & Fitness" (JIFF) is an activity based curriculum developed by Michigan State University Extension and adopted by Ohio FNP in 2004 for the summer feeding youth program in 10 Ohio Counties. In 2005, OSU Extension adopted the curriculum for use within Ohio Youth EFNEP and Ohio 4-H out-of-school-time programs. The funding that Ohio 4-H received in 2005 from the Governor of Ohio provided an opportunity for OSU Extension Family and Consumer Sciences and 4-H Youth Development to collaborate utilizing the "Jump into Food & Fitness" curriculum in several different arenas:

Youth EFNEP and the OSU Master Nutrition Volunteer Program: State and Center Specialists trained OSU Extension professionals and volunteers in each of the eleven Ohio EFNEP counties. Training included recruitment of adult volunteers, OSU Extension Volunteer policies and procedures, out-of school-time programming, curriculum training using the 7 JIFF lessons and program evaluations.

4-H After-school Nutrition Programs and Science Program in 16 pilot counties. The State Team for After-school programming (Theresa Ferrari, Graham Cochran, Cindy Torppa, Karen Jackson, Bob Horton & Forster) planned and implemented the training that occurred at Adventure Central in Spring 2005. The training included two sessions of 4 hours each in order for professionals and volunteers to implement the "Jump into Foods & Fitness" curriculum.

Impacting Youth Through Service-Learning

Using nutrition recommendations found in MyPyramid and the Dietary Guidelines and grounded in learning and behavior change theory, a new curricula – Food Fit, was developed and pilot-tested in 3 after-school (treatment) sites. Students (n = 38) enrolled in HN 704, Nutrition Programs and Services in the Community – a service learning class, were trained to administer the Food Fit program. Two undergraduate and one graduate student served as site coordinators in each of the 3 control sites. Site coordinators and HN 704 students completed CITI training.

To measure success of the Food Fit program, a post test only control group design was employed. There were 3 treatment and 3 control sites. A 13-item survey was administered to 29 subjects at the treatment sites, and 43 at the control sites. To assure adherence to program delivery standards, evaluations of the delivery process (process analysis) was also executed. To evaluate success with the training program (developed to train HN 704 undergraduate students to administer program) and the service learning component of the class, HN 704 students completed a survey upon completion of program delivery and the HN

704 class respectively.

b. Impact –

Impacting Youth Through Service-Learning

Of the 38 undergraduates 80% (n=31) where Caucasian, 10% (n=4) were African American, and 10% (n=3) were other. There were 31 females (80%) and 7 males (20%). 100% (n = 38) recommended that the service learning component of the class continue.

Over a period of 8 weeks 300 child contacts occurred. One hundred and ten (110) children attended food fit. Of this total, 55 (50%) were African American children, while 40 (36%) and 15 (14%) were with Caucasian, and other children respectively. The average number of sessions attended by these children was 2.72 sessions. Specifically, 6 children (6%) attended all 6 Food Fit lessons, while 9 (8%), 22 (20%), 20 (18%), 18 (16%), and 35 (32%) attended 5, 4, 3, 2, 1 session(s) respectively. Mean scores on a 13 item post program survey were 8 for the treatment group, (n=29) and 6 for the control group (n=43). While these differences were not statistically significant, data indicated that the program had a greater impact on children in grades 3 – 5. Similarly, as would be expected, the greater the number of lessons attended, the higher the post-test scores. Finally, these data provided useful content and process information that has been used to redesign the curricula. This new and revised curriculum will be pilot-tested during Spring 2007.

Nutrition Education in the Central Ohio Latino population: A Human Nutrition professor and Extension Specialist and his colleague targeted a community on the west side of Columbus and utilized the JIFF curriculum with the children. One goal of the project was to translate the JIFF family newsletter and an Ohio 4-H beginning food & nutrition project and a gardening project from English to Spanish. The project was successfully completed.

c. Source of Federal Funds - Smith-Lever 3b&c

d. Scope of Impact - State Specific

5. Key Theme: Nutrition Education – Dining With Diabetes

(Reference OSU Plan of Work Extension Program 3Ae: Human Nutrition/Health)

a. Description of Activity - Diabetes is reaching epidemic proportions in the United States. Receiving education about how to manage/control one's diabetes is key to maintaining or improving health and preventing complications. Parts of Ohio lack enough health care providers to adequately educate and train individuals with diabetes to manage their food intake and other aspects of their disease. Extension Family and Consumer Science Educators have teamed with local registered dietitians and certified diabetes educators to provide a 3 lesson series oriented toward helping diabetics and their families manage their diabetes by improving their food consumption practices. They have adopted a curriculum, Dining with Diabetes, that was developed by University of West Virginia Extension.

b. **Impact** - Over 850 individuals participated in Dining with Diabetes classes that were conducted in twenty-five Ohio counties. An evaluation instrument was developed and received IRB approval for us with the classes. Participants recorded increased knowledge in nutrition and food preparation skills, indicated that they were using the information learned in classes to plan meals, to monitor portion sizes more closely and to understand the importance of exercise in diabetes management.

Three issues of a Dining with Diabetes newsletter were distributed in twenty five counties to 1023 former participants of the program. Extension Educators indicated that the newsletter contained topics of importance to their participants and 95% expressed an interest in continuing the newsletter.

OSU Extension sponsored a statewide training using videoconference to train sixty Family and Consumer Sciences Educators and Registered Dietitians on the Dining with Diabetes team. Presenters for the training included diabetes researchers from The Ohio State University, health professionals from the Ohio Department of Health, health care practitioners and Dining with Diabetes Team members. Each professional who attended the training received a notebook containing activities developed by the Dining with Diabetes Team, newsletter, evaluation instruments and programming materials.

A partnership with the Ohio Department of Health was formed in 2005. As a result twelve counties were selected to conduct the Dining with Diabetes program at Federally Qualified Health Centers in 2006. Each county in the pilot received funding to conduct the program free of charge to participants. The Ohio Department of Health also worked with OSU Extension to develop a database to identify diabetes resources in each county. The program will be available on the ODH website in mid-2007.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

6. Key Theme: Human Health

(Reference OSU Plan of Work Research Program 3Ar: Human Nutrition/Health)

a. **Description of Activity** - The results of a study identifying low glycemic index carbohydrates and herbal alpha-glucosidase inhibitors for the management of postprandial glycemia demonstrated that raisins are a low glycemic index (GI) food in sedentary and prediabetic subjects and a moderate glycemic index food in endurance trained subjects. This study indicates that raisins have low to moderate impact on the blood sugar and could be a good snack food for persons with diabetes or impaired glucose tolerance. OARDC researchers also found that *Salacia oblonga* extract can significantly lower the postprandial glycemic response to a spaghetti meal by 25%. In addition, the herb wasfairly well tolerated, causing only mild to moderate flatulence as the result of its inhibition of

carbohydrate digestion in the small intestine. The herb, however, did not impact perceived satiety in the 2-h postprandial period. The human study on the negative effects of erythritol on fructose absorption showed that erythritol does impair the uptake of fructose by Caco-2 cells (a model system for human small intestinal cells).

b. **Impact** - There are three main impact areas in low glycemic index carbohydrates and herbal alpha-glucosidase inhibitors for the management of postprandial glycemia research at OARDC. The first indicates that even though raisins are a concentrated carbohydrate source and that most carbohydrates comes from sugars, their effect on blood sugar is only low to moderate. This is important information for persons with diabetes who need healthy snack foods that do not cause dramatic elevations in blood sugar. Second, studies of *S. oblonga* continue to demonstrate beneficial effects of the herb on post-meal blood glucose levels with only minimal gastrointestinal symptoms. While the third is not yet an impact per se, the questions emanating from the study are important to basic research. The human and in vitro studies generated new questions regarding the mechanism by which the sugar alcohol erythritol is absorbed from the small intestine. Understanding this mechanism is important because erythritol is frequently used as a non-caloric, non-glycemic sweetener in food products. However, erythritol's absorption may negatively affect the absorption of other sugars, such as fructose, in foods. This interaction may lead to the development of unpleasant gastrointestinal side effects (e.g., flatulence, abdominal cramping, and diarrhea). It is important to diabetics to determine how erythritol is absorbed from the intestine and the potential interactions with other dietary sugars.

c. **Source of Federal Funds** - Hatch

d. **Scope of Impact** – Multi-State

7. Key Theme: Nutraceuticals

(Reference OSU Plan of Work Research Program 3B: Nutraceuticals)

a. **Description of Activity** - Cancer is responsible for one in every four deaths in the United States and an astounding $209 billion in overall costs every year. However, as much as one-third of the country's cancer deaths could be prevented, as they are in part related to physical inactivity and nutrition. The American Cancer Society reported that Ohio saw more than 24,000 deaths and 61,000 new cases of cancer in 2006. Research on functional foods that can help prevent diseases not only leads to good health, but also good business. Battelle Memorial Institute estimates the U.S. market for functional foods at $18 billion. OARDC researchers are collaborating with OSU medical researchers to study how certain foods can stop or slow certain cancers and impact other chronic diseases.

Given that one in three Americans will contract cancer at some point during their lifespan, OARDC is committed to research into phytochemicals and health. Findings include how lycopene in tomatoes battles prostate cancer. About 232,000 new cases of prostate cancer are diagnosed each year. Reducing the incidence just by 5 percent would trim $400 million from the estimated $8 billion

spent annually on prostate cancer treatment and dramatically improve the quality of life for many. The American Cancer Society estimates that 63,210 cases of bladder cancer were diagnosed in 2005, with 13,180 deaths. Economic studies indicate that, in addition to the human tragedy, direct medical expenditures related to bladder cancer amounted to almost $3.7 billion in 2001.

OARDC's "crop to-clinic" research addresses among other topics how berries can stop or slow some of the biological processes that contribute to the development or spread of different types of cancer. Black and red raspberries, blackberries, strawberries, and elderberries are some of the fruits whose disease fighting power is being researched. Berries contain a number of compounds that have been shown to have anti-carcinogenic properties, including vitamins A, C, and E, selenium, ellagic acid, and manthocyanins (which give berries their color). Such promising results have led to the establishment of human clinical trials. In one of the studies, patients with early-stage colon cancer are fed freeze-dried black raspberries. Other studies are examining the effect of black raspberries in liquid form to treat patients with esophageal cancer. Researchers in another trial are evaluating the berries in a chewy, lozenge form in patients with oral cancers. While definitive impacts are not yet fully understood, these findings are already having major positive impact on the food industry and on food selection behavior by many citizens.

OARDC has had a long history of studying tomatoes and lycopene. A recent study has shown that while red tomatoes contain far more lycopene than orange tomatoes, most of it is in a form that the body does not absorb well.

b. **Impact** - Food, horticultural, medical, and dental researchers at The Ohio State University are demonstrating how black raspberries can stop or slow the biological processes that lead to oral, esophageal, and colon cancers. In another effort, scientists have isolated compounds from broccoli that has potential fight bladder cancer. In laboratory studies, project scientists have found that freeze-dried berries can inhibit the development of oral, esophageal, and colon cancers in rodents. The berries prevented carcinogens from being converted into forms that cause DNA damage and also slowed the growth of pre-malignant cells. The research team has also developed a raspberry bio-adhesive gel that will be used to treat people with pre-cancerous lesions in their mouths. The project has received targeted federal funds to study the potential of protective effects of berries on, among other things, cancers of the cervix and skin.

Lycopene in tomatoes is a major nutraceutical. In the OARDC tomato and lycopene study subjects actually consumed less lycopene when they ate sauce made from the orange tomatoes, but they absorbed far more lycopene than they would have if it had come from red tomatoes.

c. **Source of Federal Funds** – Hatch

d. **Scope of Impact** – Multi-State

Goal 4. Greater Harmony between Agriculture and the Environment

Executive Summary

A sustainable food and fiber industry is underpinned by a sound natural resource conservation and environmental management program. OARDC has been vested in such programs since the inception of the experiment station when it created forestry, fisheries, and wildlife program in the late 1880's. OARDC has a long history of land reclamation research and the safe utilization of industrial byproducts as soil enhancers and fertilizers. In the 1960s, The Ohio State University was one of the early agriculture programs to establish a natural resource program and has long provided national leadership in areas such as the soil sciences. Related research is presented under this goal.

A successful integrated pest management program is central to sustaining the food and fiber industry and minimizing environmental impacts. OARDC scientists have demonstrated that crops grown under long term organic management have resistance to certain insect pests, and that this finding is related to soil biological and chemical characteristics, referred to as biological buffering. Without continued efforts to understand and employ the advantages offered through integrated pest management, functioning ecosystems will be negatively impacted.

Vermicomposts, nematodes as useful bio-weapons against pests, night crawlers as promoters of weed growth, and the role of biological calendars are discussed under this goal. Additionally advances made in organic farming and multiple ecosystem management impacts are presented.

As livestock production continues to expand in Ohio and with the odors, dust, insect pests, and water pollution associated with the increased numbers, there is a need to provide educational programs to producers on composting livestock mortality and composting animal waste. Due to the diverse distribution of the state's population, livestock producers, commodity groups and OSU Extension are taking a pro-active approach to improve neighbor relations by providing programs that ameliorate issues associated with agricultural waste.

Ohio contains nearly 7.9 million acres of forests and woodlands. OSU Extension regional specialists, county educators and Soil and Water Conservation District personnel provide newsletters and best management practice workshops across the State, addressing a wide variety of topics, including but not limited to House Bill 88 - Agriculture Pollution Abatement Law and issues related to silvicultural non-point source pollution.

OSU Extension, working in partnership with the Ohio Livestock Coalition and key state and federal agencies, has developed and implemented the Ohio Livestock Environmental Assurance Program (LEAP). LEAP helps livestock producers to profitably manage environmental challenges that are critically important to the success of their business.

Smith-Lever Fund expenditures for Goal 4: $1,333,177 EXTENSION FTE's: 19.0
Hatch expenditures for Goal 4: $1,249,227 OARDC FTE: 9.4

Goal 4 Key Themes

1. Key Theme: Agricultural Waste Management

(Reference OSU Plan of Work Extension Program 4Ae: Agricultural Wastes and By-Products)

a. **Description of Activity** – In 2006, OSU Extension sponsored and conducted many programs in Agriculture and waste management including: Manure Science Review, Midwest Professional Nutrient Applicator's Association training (MPNAA), Certified Livestock Manager Program (CLM) air quality programs for animal feeding operations, and the Manure Management Issues program. Specific activities and impacts follow.

b. **Impact** - The Manure Science Review program is a statewide manure management education program targeting animal operations. This multi-agency and organizational program focuses on environmental, economic and production issues critical to animal operations in this state with an emphasis on Best Available Technology for manure handling, treatment and storage. The MSR program provides continuing education credits for Ohio's Certified Crop Consultants individuals dealing directly with animal manure over two days at two locations across Ohio. This program specifically targets animal producers with important information about animal manure management. This program had over 250 growers, consultants, professionals and policy makers attend.

The Midwest Professional Nutrient Applicators Association (MPNAA) is a multi-state organization developed in conjunction with commercial applicators to provide educational opportunities specifically for those engaged in for-hire manure application. Over 75% of the membership is certified under Ohio's Certified Livestock Manager program. More than 280 custom manure applicators, animal producers, consultants and allied industry professionals received manure nutrient management training in addition to spill response, winter application and preferential flow training in 2006.

Manure from large livestock and poultry farms can be an asset when handled and recycled properly as nutrient resource. It can also be the largest liability for a farm when handled incorrectly. In 2006 the Ohio State University Extension in collaboration with Ohio Department of Agriculture co-sponsor two to three Certified Livestock Manager training sessions annually for nearly 300 animal producers, and custom manure applicator. This two-day training session will provide nutrient management training, manure storage and handling training, emergency management planning, insect and rodent control practices, and a review of the rule and regulations concerning manure handing. This training session enables participants to complete all the training needed to become certified in Ohio under this program. Certified Livestock Managers will need 10 hours of continuing education every three years to maintain certification.

Increasing odor and air quality concerns have created a major challenge for the viability and growth of Ohio's animal producers. U.S. EPA has signed an air quality compliance agreement with animal feeding operations (AFOs) which explicitly states that all AFOs need to comply with federal air quality regulations. Management of air emissions from these operations is a major challenge that Ohio livestock and poultry producers face. Science based research and best available technologies and management practices associated with these air emissions will enable Ohio's animal producers to effectively manage these air quality issues. More than 100 individuals attended air quality educational programs in 2006. These programs included an air quality in-service targeting animal producers and

associated professionals on new regulations and research efforts pertaining to animal agriculture, as well as a engineering workshop focused on designing and installing biofilters on mechanically ventilated facilities.

Over the past several years, manure application to farm fields has come under additional scrutiny, particularly the applications of manure to frozen and/or snow covered ground. Livestock producers and custom manure applicators should always exert extreme caution, follow best management practices (BMPs) and utilize best available technologies (BATs) when applying manure, particularly when field conditions are less than ideal, which would definitely include winter-time application. The top priority of any application of nutrients to the land should be to protect water quality. Manure Management Issues, Challenges & Solutions Program was developed in cooperation with Ohio's agricultural commodity organizations, regulatory and state agency partners to further educate producers on manure management when application conditions are less than ideal. To date more than 454 individuals have participated in these programs.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

2. Key Theme: Nutrient Management

(Reference OSU Plan of Work Extension Program 4Ae: Agricultural Wastes and By-Products)

a. **Description of Activity** - The Livestock Environmental Assurance Program (LEAP) continues to advance environmental stewardship educational programming in Ohio in 2005. LEAP programming continues to expand with the addition of LEAP-Pasture and the development of LEAP-Youth and LEAP-Equine.

Since 1997, nearly 6,000 individuals from all major animal commodity groups in Ohio, including horses, have participated in a LEAP training program. Beef producers had the highest number of individuals participating, while poultry and dairy had the largest percentage of total producers participating, followed by swine, beef, sheep and horses.

There is a growing need for environmental education within agricultural education curriculum. Forty-eight percent of respondents in a survey of Ohio livestock producers identified manure management as the greatest environmental challenge facing their operations. Odor, soil erosion, and water quality issues were identified as additional issues critical to the future success of animal operations in Ohio. A student Livestock Environmental Assurance Program incorporates unique outreach opportunities for cooperative interaction among government environmental organizations, livestock commodity groups, and local producers or research facilities. The involvement of these organizations will enhance the educational experience and reach beyond the boundaries of traditional adult and youth education. Youth and Youth Educators will be exposed to a diverse group of scientists who will share a rich knowledge base focused on environmental protection and enhancement from the animal producer’s

perspective. These individuals will be able to integrate their scientific, environmental, and ecological knowledge into the daily management, benefiting society as a whole, and linking agriculture, the food systems, and public health.

The primary objective of this program in youth livestock environmental assurance (LEAP-Youth) is to develop the next generation of highly qualified livestock producers, university, government and industry leaders, with a global perspective, and the ability to interface with numerous disciplines as they address the public's need for a safe, healthy food production system and maintaining a safe environment.

LEAP, Level 2 continues to target animal producers with more advance environmental stewardship training. LEAP, Level 2 addresses issues related to manure and wastewater handling and storage, feed management, land application practices, nutrient management, record keeping and other utilization options. Implementation plans emphasize Best Available Technologies (BAT) and Best Management Practices (BMP) to efficiently address and minimize the impact and effect from dust, noise, odors and pests on the respective farm, farm neighbors and the community. LEAP, Level 2 is designed to help producers obtain and organize data and information, as well as identify appropriate technologies necessary to implement a Comprehensive Nutrient Management Plan (CNMP) for their operation.

The LEAP-Equine program's curriculum focuses on key issues that are critically important to the success of an equine operation developing and implementing practices that are economically viable, environmentally friendly and socially acceptable. Specific topics that will be addressed during the training session include protecting water quality, manure and nutrient management, pasture management, facility design, conservation practices, neighbor relations, regulatory compliance and Ohio's equine liability law.

In Ohio, horses, donkeys, mules and ponies are defined as livestock, and just as other species of livestock are making environmental, conservation and natural resource issues a priority, so must Ohio's equine industry. Unfortunately, in some areas of the state, improper handling, application and/or disposal of manure from horse farms is now the leading source of verified agriculture pollution complaints. This program is specifically designed for horse farm and ranch owners, operators and managers interested in developing and implementing practices that are economically viable, environmentally friendly and socially acceptable.

- Create awareness of environmental, conservation and natural resource issues that must be addressed by Ohio's equine industry.
- Become more familiar with best management practices (BMPs) and best available technologies (BATs) that will specifically help your horse farm better identify and address environmental, conservation and natural resource issues and challenges.
- Reduce the number of verified ag pollution complaints involving horse farms.
- Identify various alternatives for manure handling, storage, application, utilization and disposal.
- Learn how to manage, handle, store and apply manure in a manner that protects the environment and conserves precious natural resources.

- Learn how to manage pasture, hay, forages and grasses in a manner that enhances animal nutrition and utilization, efficiency and use of resources, maximizes profit and protects the environment.
- Use information from the personal self-assessment to improve your horse farm's management and facilities, which in turn will lead to better protection of the environment and natural resources.
- Develop a comprehensive understanding of environmental rules and regulations by which horse farms must comply.
- Adopt and implement good neighbor policies that create a positive perception of the equine industry.
- Develop an understanding of programs and incentives made available by various government agencies that may benefit your horse farm.

b. **Impact** – Over 6000 individuals from all major commodity groups in Ohio have participated in a LEAP level 1 and LEAP Pasture training program. More than 150 individuals have attended a LEAP Level 2 training.

LEAP-Student was introduced more than 100 new and seasoned vocation agriculture educators. The primary goal of the new student version of LEAP is to produce a new generation of highly qualified individuals who can work in fields that interface production agriculture with the environment, specifically, manure management, air, and water quality issues while linking environmental assurance with agriculture, food production systems and public health. This program's curriculum matches-up with agricultural education standards for plant science, animal science, business operations and environmental science. Twenty-nine benchmarks in the areas of care and management, contaminates, plant nutrition, water, air, land, waste management, emergency response and issue identification/discussion are identified in each of the program's 13 chapters.

c. **Source of Federal Funds** – Smith-Lever 3b&c

d. **Scope of Impact** – State Specific

3. Key Theme: Agricultural Wastes and By-Products

(Reference OSU Plan of Work Research Program 4Ar: Agricultural Wastes and By-Products)

a. **Description of Activity** - Environmental concerns with animal waste point-source pollution have centered on the concentrated nutrients contained within the waste, and the potential flow of these into surface and groundwater. Approximately 15 million tons of animal waste in Ohio is estimated to contain 190 million pounds of nitrogen and 52 million pounds of phosphorus. Composting of this and all other organic waste streams is a focal area of OARDC research.

One such compost, vermicompost, can influence plant growth significantly through the production of biological/chemical plant growth-influencing agents such as plant growth regulators or humic acids, in addition to their effects on transformations of direct nutrient inputs in greenhouse experiments. OARDC scientists have shown that interactions between earthworms and microorganisms produce materials that affect plant growth. This

raises very important implications for utilization of organic wastes as inputs to crop production and also for agroecosystem functioning. Earthworms and microorganisms can promote the production of plant growth-influencing substances from organic matter in amounts that can influence plant growth significantly over and above that due to nutrient inputs. The ecological and economic importance of the utilization and turnover of organic matter in agroecosystems has a significant impact.

b. **Impacts -** In studies of the physical, chemical and biological properties of the three vermicomposts there were considerable increases in NO3-N, soluble P, and exchangeable Ca and Mg, with large decreases in the C:N ratio during vermicomposting. Organic matter became much more fragmented, with more aggregates and greater water-holding capacity, and decreased bulk density. The microbial biomass, activity and diversity increased significantly. Field soils that received the vermicomposts had larger total organic matter contents and more microbial biomass and greater microbial activities and retained moisture better. The crops that received vermicomposts consistently and significantly out-yielded the crops receiving only inorganic fertilizers. Vermicomposts and aqueous vermicompost extracts (teas) decreased plant parasitic nematode attacks and incidence of blossom end rots on tomatoes, bacterial wilt, early blight, powdery mildew, verticillium wilt, and *Phomopsis*. With the use of vermicomposts there were significant suppressions of attacks by cucumber beetles aphids and hornworms.

c. **Source of Federal Funds** – Hatch

d. **Scope of Impact** – Multi-State

4. Key Theme: Integrated Pest Management

(Reference OSU Plan of Work Research Program 4B: Integrated Pest Management)

a. **Description of Activity** - OARDC scientists are on their way to creating a bio-weapon against insect pests that destroy valuable agricultural crops, urban-landscape greenery, livestock, and that can have major negative impact humans and their pets. The US spends billions of dollars annually and massive amounts of toxic chemicals trying to exterminate insect pests.

The National Institutes of Health (NIH) and the U.S. Department of Agriculture (USDA) are working with OARDC to sequence the genome of insect-parasitic nematodes — microscopic roundworms that have proven to be highly effective biological insecticides against a wide variety of pests. Specifically the project involves sequencing and interpreting the genome of *Heterorhabditis bacteriophora*, one of the most effective insect-parasitic nematodes known. This research accesses novel genetic tools that would "revolutionize" biological control by boosting the effectiveness of nematodes as insect killers, increase the number of their target pests and the environments where they could be applied, and makes the nematodes cheap enough so they can be cost-effective for use in high-acreage crops such as corn and cotton.

These have also shown promise against animal and human pests such as

ticks and lice. The nematodes feed on the bacteria, and then reproduce and migrate in search of new hosts to infect. Since they are living organisms, nematodes have a short shelf life compared to synthetic pesticides. They are also sensitive to light, run the risk of drying up, and must be kept in refrigerated conditions during shipping and storage. All of these factors prevent their use for other than soil-dwelling insects and make them expensive, especially for large farming operations.

This research project addresses functional genomics that seeks to identify nematodes with desired traits in the field. Also switching genes on and off to improve certain characteristics are important in biological control. Transgenic nematodes that can be stored longer and are more virulent so that consumers will need fewer nematodes to achieve desired results would reduce the price significantly.

On another front, common night crawlers have been found to play a role in weed survival by seeking out and "collecting" seed, according to OARDC researchers. While worms are excellent for soil health, the worms' weed seed propagation is problematic. Such behavior may help explain the prolific nature of certain weeds in Ohio, such as giant ragweed. The findings mark the first recorded associations between earthworm behavior and seed dispersal of a giant ragweed seeds. The native annual ragweed is so successful it has been labeled as one of the most stubborn weeds in Ohio to control. In a study to analyze why giant ragweed is so successful in crop fields, OARDC scientists found that earthworms were collecting the seeds around their burrows, for undetermined reasons. For the most part animals, especially mice, consume most of a giant ragweed seed crop. But the weed continued to pop up more frequently than anticipated, and even established itself in abandoned fields, meadows, and forest borders, which are ideal habitats for mice. Whatever the reason, giant ragweed seed seems to be an earthworm's favorite item to collect.

Also of research importance is the life cycle of pest species that were used to construct a Biological Calendar <www.oardc.ohio-state/gdd> for predicting pest activity and vulnerability to control tactics. As a follow-up to this study that established the calendar, The OSU Phenology Garden Network initiated observations at 34 locations across Ohio. Each garden contains identical plant materials with a blooming sequence spanning the growing season. Phenological data are monitored weekly by volunteer Master Gardeners and posted to the Phenology Garden website <www.phenology.osu>, where it is used to validate predictions of the Biological Calendar. Scientists fine-tune local timing recommendations for pest management practices. Also as part of this work, pesticide efficacy studies are also carried out on key pests of trees and shrubs with emphasis on new technologies for ornamental landscapes, as well as new products for difficult to control pests such as woodborer, bark beetles, scales and spider mites.

OARDC scientists are also studying new technologies to manage pest. Spray application technology trials evaluated coverage and efficacy of pesticides applied by several systems. Plant population trials evaluated whether wider plant spacing and lower total plant population could decrease insect and disease incidence, or increase pesticide efficacy and yield of peppers. The highest yield

resulted after application by a conventional boom sprayer with air induction nozzles operated at high speed or low speed, and the boom sprayer with twin flat-fan nozzles at low speed. The electrostatic sprayer resulted in lower yield than the conventional boom sprayer treatments. A trial on interactions of plant populations and spray technology evaluated which technology was better for denser plantings. The results of these trials have been shared with commercial growers to assist in their adoption of improved crop production tactics.

Another pest management strategy by OARDC is monitoring and predicting insect activity for Ohio's agriculture industry. Ohio did not have problems with the soybean aphid in 2006 that had been predicted based on observations in the fall of 2005 and the lack of over-wintering aphids on buckthorn. The low number of soybean aphids was consistent with that observed throughout the Midwest. Fall sampling during October in buckthorn in a number of areas in the state indicated large populations of aphids colonizing buckthorn. Later observations of significant numbers of aphid eggs have been made. Based on these observations, OARDC scientists have predicted significant soybean aphid problems in 2007.

Also gathering knowledge of the size and weight of slugs combined with planting date and crop emergence will lead to more suitable Integrated Pest Management practices for controlling slugs. A study of insect pests on organic soybeans show that although soybean aphid numbers were low this year, late maturing organic soybeans in northwest Ohio experienced extremely large numbers of bean leaf beetle and pod feeding. In some organic fields in, beetle counts were over 800 adult bean leaf beetles per ten sweeps, and pod injury was over 50% of the pods showing feeding.

b. **Impact** - Managing slugs, among other pests, is a major issue in Ohio agriculture. Advances in insect-parasitic nematodes, currently a $10 million industry worldwide, can be turned into a billion-dollar business. But more importantly, increased use of these biocontrol agents would help reduce the environmental and human-health risks of chemical insecticides, while contributing to deter global crop losses due to insect pests — estimated at 13 percent to 16 percent, or $244 billion per year. Nematodes, for example, are the only control available for black vine weevil and cranberry girdler in North American cranberry bogs. Nematodes are the most effective killers of white grubs in turfgrass.

Gene expression profiles of *M. osloensis* during slug infection were investigated using a powerful new technique called Selective Capture of Transcribed Sequences (SCOTS). Using this technique, scientists identified 11 bacterial genes that were activated during slug infection. One of these genes is totally new, as it has never been reported from any pathogen. Using knock-out (mutation) techniques, scientists confirmed three of the other ten genes to be virulence genes. A gene that encodes for the enzyme ubiquinone synthetase was found to act as a virulence gene in *M. osloensis* in the slug. This gene has not been considered a virulence gene in any pathogen before as it only helps bacteria survive in adverse environmental conditions

The information gathered during the course of this project illustrates the significance of the bacterium in this nematode-bacterium parasitic complex, thus pointing to importance of maintaining the association between the nematodes and

the bacterium during commercial production. In the long-term, this information is already proving useful in identifying and developing more effective strains of the bacterium to improve the field efficacy of the nematode-bacterium complex against pest slugs.

Researchers are also discussing whether the relationship between seeds and earthworms might be one of co-evolution. By burying the seeds, the earthworm may increase the chances of a seed's survival and establishment. In exchange, burial of the seed in the burrow may reward the earthworm by providing nutrients as the outer coverings of the seeds decompose, by strengthening burrow walls, or, ultimately, by providing a future supply of plant litter upon which the earthworm feeds.

This relationship apparently aids giant ragweed, a major weed in Ohio agriculture in establishing itself, especially in no-tillage crop fields and undisturbed areas where mice, major weed eaters, are plentiful and there are few means by which a large seed are naturally buried. This knowledge is uselful as a basis for managing for weeds.

Ohio's Green Industry generated $4.2 billion in economic impact in 2006. Arthropod pests reduce plant quality and grower profits. OARDC has generated replacements for insecticide registrations cancelled due to Food Quality Protection Act and increased the effectiveness of pest management programs. OARDC scientists and community partners (Master Gardners) have shown that an easily monitored flowering sequence of ornamental plants can be used as a Biological Calendar to accurately predict the phenology of key insect pests and weeds, and to time pest management tactics. By making degree-day data more user-friendly and accessible, this web-based information has improved monitoring of pests and decreased pesticide use, resulting in increased profits of growers and green industry firms by decreasing expenses and economic losses to pests, while enhancing environmental quality and the safety of agricultural workers and the general public.

Also important to the green industry is appropriate use of sprayer technologies for pest management. Field trial research demonstrated how different pesticide spraying regimes are used to improve yield and quality of bell peppers. Field trials also showed that control of European corn borer and anthracnose was improved when pesticides were applied with a conventional boom sprayer with air induction nozzles or twin flat-fan nozzles. The results of these trials have been shared with commercial growers to assist in their adoption of improved crop production tactics.

Pest monitoring and reporting is of tremendous economic importance. Monitoring of pests in 2006 correctly predicted that soybean aphid would be a problem in 2007. This provided growers with advanced information allowing them to save millions of dollars by not over spraying. OARDC generated predictions of problems in 2007 is allowing growers to make preparations for dealing with the aphid problem, again staving off a major threat in the 2007 growing season.

c. Source of Federal Funds – Hatch

d. Scope of Impact – Multi-State

5. Key Theme: Organic Agriculture

(Reference OSU Plan of Work Research Program 4C: Organic Agriculture)

a. Description of Activity - OARDC scientist have demonstrated that given the right conditions, organic farming can produce, on average, as much corn per acre in Ohio as conventional farming can. Corn hybrids grown in last year's Ohio State Organic Corn Performance Test produced 13 percent more corn per acre than the statewide average yield - most of that conventional corn - and topped the record-high state average yield by four bushels per acre. One hybrid tested did even better, beating last year's state average corn yield by nearly 50 percent.

Traditional wisdom has held that organic corn yields in Ohio are considerably lower than conventional yields. OARDC researchers compared 23 organic corn hybrids. Generally speaking, organic farming takes more work than conventional farming but growers are paid more per unit for what is grown, often as much as twofold plus. Organic farmers cannot grow corn as often as conventional farmers can; they must rotate it with other crops more often than under conventional regimes. In a given field in a four-year span, an organic farmer might plant corn once, a conventional farmer twice or even every year.

b. Impact - As OARDC scientist continue to demonstrate through unbiased, science-based recommendations, that options for Ohio organic farming do exists. The study showing equal or superior performance of organic corn with conventionally grown corn provides Ohio farmers with additional options to adopt new technologies and open new markets. National trends are showing that organic corn and soybeans produce as much as their conventionally grown counterparts - more under drought - while requiring 30 percent less fossil energy, less water, and no synthetic pesticides.

c. Source of Federal Funds – Hatch

d. Scope of Impact – Multi-State

6. Key Theme: Water Quality

(Reference OSU Plan of Work Research Program 4Dr: Water Quality)

a. Description of Activity - The Ohio Environmental Protection Agency ranks north-central Ohio's Sugar Creek watershed, encompassing parts of Wayne and Holmes counties, as one of the most impaired in Ohio due to sedimentation, nutrient enrichment, bacterial contamination, and loss of riparian (streamside) habitat. OARDC researchers and OSU Extension faculty are improving the situation. Farmers in the watershed now use at least 12 different Best Management Practices (BMPs), practical, effective, scientifically proven ways to keep water clean and healthy, by teaming with OARDC's Sugar Creek Watershed Project.

Started six years ago by OARDC's Agroecosystems Management Program (AMP), the project combines science with the local

community including farmers, residents, businesses, municipal officials, and others to tackle a complex challenge: improving environmental quality throughout the entire watershed. Greater use of BMPs with details, assistance, and materials from the project for free or on a cost-share basis, is a key to success.

The project has, among other things, cut the amount of nitrates (the cause of "blue baby" syndrome), phosphorus (which fuels algal blooms), sediments (which turn water muddy), and bacteria (such as E. coli) that run off into the water. Yet farmers and businesses alike are boosting their earnings.

b. **Impact** - In the Sugar Creek (Ohio) watershed, one science-based method, called the Late Spring Nitrate Test, helped a watershed farmer slash his spending on nitrogen fertilizer by $3,000. Using the test can reduce how much nitrate gets into water by nearly a third. Another Best Management Practice (BMP) — livestock exclusion fencing — is keeping farm animals away from streams, increases soil organic matter, increases biodiversity, and protects against wind and water erosion. One dairy farmer who worked with the project saw his milk quality soar (thus earning a price premium) and mastitis (infection of the udder) rate plummet after installing the fencing. A third BMP, riparian buffers, has created at least eight miles of new, contiguous buffers in the upper part of the watershed alone. The buffers have potential to stop about 75 percent of the nitrates that enter the stream and serve as a reservoir for phosphorus, keeping it from entering the stream.

c. **Source of Federal Funds** - Hatch

d. **Scope of Impact** – Multi-State

7. Key Theme: Ecosystem Based Management

(Reference OSU Plan of Work Research Program 4F: Ecosystem Based Management)

a. **Description of Activity** - An urban ecosystems management focused study in Toledo, Ohio has identified a significant loss in numbers of *Fraxinus* species to Emerald Ash Borer (EAB). The city is in the process of removing some 5,000 street trees. To address this problem, four street segments were selected for analysis by OARDC researchers. Residents were asked about their attitudes toward their street and neighborhood, and their street trees, as well as desirable and detrimental traits of trees. Residents seemed to appreciate a diverse mix featuring a variety of colors, habits and growth rates. A number of fast growing larger trees were desired as the loss of shading and the lack of canopy along the street were thought to make the area appear less mature and less attractive than before.

An iTree analysis of the same four Toledo streets was conducted using the STRATUM engine. The landscape loss calculations were modified to use Ohio valuation procedures. The loss of ash on the four streets represents a landscape loss of more than $436,000 of the $775,000 total original value. Tree removal costs for the 131 trees are nearly $170,000. Replacing the trees that have been removed with much smaller 5 cm (2-in) trees will cost an additional $38,000. Economic, environmental, and quality of life impacts due to the EAB are

dramatic.

Soils may be considered an ecosystem; under agriculture production they are subject to a number stresses. No-till is a commonly used crop production system in many countries. Crop yields may be initially decreased when soils are converted from a plow tillage system to no-till. Increasing the organic matter concentration in the soil at the surface seems key in overcoming these initial stresses/yield declines and restoring some of the ecosystem function. OARDC researchers found that applying organic amendments consisting of fresh and composted wheat straw-bedded cow manure, where plow tillage crops had previously been grown, significantly increased the concentrations of organic matter, and the total N, NO3-N, K, and P.

In soil ecosystem studies, soil quality is an important indicator soil ecosystem health. In one study OARDC scientists investigated changes in soil properties due to deforestation, cultivation, and tillage. Soil profiles were examined and sampled in 44-year-old monoculture no-tillage (NT) research plot at OARDC – Wooster and in plow-till (PT) plots and grassed and wooded areas adjacent to the plots. In the cultivated plots, soil structural development was strongest under grass followed by NT and then PT. This suggests continuous, long-term NT management can sustain or even enhance soil quality. In other OARDC studies, soil quality was much superior in the permanent pasture and uncut forest than with any of the cultivated tracts. The highest quality in the cultivated soils was noted in the no-till corn-soybean rotation with use of aerway equipment followed closely by continuous no-till soybeans with a cover crop.

Ecosystem management requires mitigation of human activities. Mine runoff is a major environmental concern. Oxidation of metal sulfides found in mine tailings is a complex process that may lead to phytotoxic levels of various metals in the environment. Phytotoxic levels of Zn were observed in a pyrite rich sludge deposits.

In another project addressing soil toxicity, significant progress has been made at OARDC in determining the ability of soil chemical speciation methods to predict toxicity and risk-based endpoints of heavy metal contaminated soil. Progress was made on determining the ability of chemical speciation methods that measure heavy metal bioavailability, to estimate toxicity of contaminated soil to human and ecological receptors. Progress was also made on understanding the effect of soil chemical properties on chemical speciation and heavy metal bioavailability in contaminated soil and the ability of soil chemical properties to define ecotoxicity categories in development at OARDC of an Ecological Soil Screening Levels.

In parallel work, in vitro gastrointestinal (IVG) methods were developed to provide an expedient and inexpensive means to estimate bioavailability of arsenic and other contaminants from ingestion of contaminated soil. Both vitro and in vitro techniques have used a fasting model when determining Pb bioavailability and bioaccessibility as a conservative estimate of risk. Also, the effect of phosphate from the DV on IVG BA was investigated. The IVG method, with or without DV, is a reliable method to use as a rapid screening tool to provide an estimate of BA in contaminated soils.

Additional parallel research focused on (i) the ability of the ability of in

situ amendments to reduce the gastrointestinal bioavailability of arsenic and lead, (ii) beneficial use of by products, and (iii) the long-term bioavailability and toxicity of trace elements in biosolids-amended agricultural soils. The ability of soil amendments to decrease risk associated with ingestion of soil with arsenic and lead was determined. The long-term bioavailability and ecotoxicity of trace elements contaminants land applied with biosolids was determined. Laboratory bioassays were performed on soils that had received and had not received biosolids for 12 years. Results showed that trace element bioavailability in perennial ryegrass and earthworms were low in the biosolids-treated soils. Toxicity from biosolids was not observed in the bioassays. Trace elements and nutrients from biosolids application alleviated potential copper and zinc micronutrients deficiencies and greatly increased ryegrass biomass.

Investigation of riparian forests in urban landscapes system informs ecosystem management as well. OARDC scientists have completed a six-year study of bird communities at 28 riparian-forest sites in central Ohio along an urbanization gradient ranging from primarily agricultural matrices to urbanizing matrices. Birds are major indicators of ecosystem change, adaptability, and sustainability. Dr. Amanda Rodewald's research team has monitored bird communities of Acadian Flycatchers and Northern Cardinals and their habitat characteristics. Results show that urban-associated changes in bird communities are complex and not due to relatively strictly demographic processes, such as low reproductive success due to nest predation or abundant food supplies that increase reproductive potential and survival. Instead, behavioral decisions made at individual levels (e.g., settlement, nest-site selection, decision rules about site fidelity) may play an important role in generating landscape-scale patterns and informing landscape-scale planning.

b. **Impact** - Ohio communities are faced with potential losses estimated to range from 1.8 (median based) to 7.6 (mean based) billion dollars from Emerald Ash Borer (EAB). Community losses include the loss in landscape value, tree stump removal, and replacement with a two-inch tree. In the face of such costs, communities have begun to plan for a future with EAB. Communities must update existing inventories or create new ones to effectively plan. The USDA Forest Service has recently released the iTree suite of freeware that can assist communities in this effort but assistance is need to aid communities in using the software or adapting an existing inventory to allow the computation of ecological and aesthetic benefits. Some communities are now using GIS systems that require adapting to use iTree. Community leaders increasingly require justification in order to fund urban forestry programs in the face of competing needs such as public safety. OARDC and OSU Extension scientists are combining science and outreach to help communities monitor and be better prepared for EAB.

With increasing pressure on our soils to produce food, fiber, and raw materials for energy and bioproducts, crop production systems that are sustainable need to be developed. Organic residues (i.e. crop resides, manures and/or composts) are important components of systems that maintain good soil quality. OARDC scientists evaluated ways that would best integrate application of either raw (strawy) cow manure or composted manure to soil that was being newly converted from plow tillage to no-tillage. Since manures are not mixed into the

soil with no-tillage, applications of highly degradable manures were found to reduce crop emergence and crop yields. However, applying them in the fall or composting the manures first before applying them to soil overcomes these limitations. This information is helping farmers optimally manage their manures for production of crops.

OARDC studies have emphasized the impact of soil management, particularly tillage methods, on soil quality. An improved understanding of how soil management affects soil quality fosters the adoption of management practices that will decrease the degradation of our soil resource and improve the ability of our soils to meet the demands of an ever-expanding world population. OARDC long-term no-till studies are central to national understanding of soil management and are now being looked to for informing global climate change science.

OARDC scientists' work demonstrates that the oxidation of metal sulfides occurring in mine tailings is a complex process that may lead to phytotoxic levels of various metals in the environment. In the case of mine tailings containing sphalerite (ZnS), the release of soluble, plant-available Zn is enhanced through particle-to-particle contact with other sulfide minerals, especially pyrite (FeS2). The rapid oxidation of ZnS in such sediments indicates a need for the rapid adoption of remediation techniques, such as the addition of calcium carbonate (agricultural lime). The use of calcite amendments has little influence on the oxidation rate of ZnS but does result in the conversion of soluble Zn to relatively insoluble hyroxicarbonate minerals, thereby eliminating concerns about the release of Zn at levels toxic to plants.

Inexpensive in vitro methods may be useful in estimating the relative bioavailability of contaminants in soils. Because in vitro methods are inexpensive, they can be used to analyze large numbers of soil samples and provide an estimate of the variability in bioavailable contaminant at a single study site. Inexpensive in vitro methods may be useful in estimating the relative bioavailability of contaminants in soils. An OARDC research group reported the first in vitro method for estimating bioavailable arsenic in contaminated soil. Results suggest the worst-case scenario for As bioaccessibility from soil ingestion is when the soil is ingested with high-phosphate food. For vitro methods used for lead stress, the worst-case scenario is when soil is ingested under fasting conditions. However, these in vitro methods may have to incorporate food to determine worst-case scenarios for ingestion of soil containing arsenic. Measurement of key soil properties could be used as an indicator tool at contaminated sites to determine whether site remediation is necessary.

Center research results also provide a measure of the relative contribution of each soil property in modifying lead bioavailability and toxicity. The results from this project provide risk assessors with tools to make better initial estimates of contaminated soil risk and determine whether any further assessment is warranted. Remediation costs associated with excavation and replacement of contaminated soil exceeding $10,000,000 per site are not uncommon. Use of soil properties to adjust risk may eliminate unnecessary soil remediation action and result in large remedial cost savings.

Using soil amendments for ecological restoration is an attractive remediation method that may soon gain acceptance by regulatory agencies. Using

soil amendment is an attractive technology when one considers that current technology of excavation and replacement of contaminated soil often ranges from 10 to 200 million dollars. Remediation costs using soil amendments will be less than 1% of the cost using current remediation methods. Regardless of the remediation technology, risk from ingestion of contaminated soil must be reduced for the technology to be adopted. OARDC results show that inexpensive Fe and Al oxide soil amendments can absorb arsenic strongly and reduce bioavailability and risk associated with ingestion of oxide treated arsenic contaminated soil. Results from OARDC long-term biosolids field study shows that land application of biosolids improved plant nutrition and did not result ecotoxicity to plants or earthworms. Soil analysis suggests most of the organic fraction of the biosolids had decomposed, indicating reaction of biosolids with soil was essentially complete. Biosolids improved soil properties and plant growth and did not have a negative ecosystem effect. These results suggest land application of biosolids remains a sustainable practice.

The OARDC forest research is important because it demonstrates that the landscape surrounding forested habitats can exert strong pressures on animal communities. Thus, programs aimed at conserving the biodiversity and ecological integrity of riparian and upland forests need to carefully consider the impacts of urban development. For example, if development is allowed to border parks, refuges, and forest reserves, the plant and bird communities may be negatively affected. Buffers are critical. Applications of this research include the (1) generation of specific recommendations for forest management that can be directly used by agencies and private landowners and (2) identification of forest birds that are especially sensitive to urban development and silviculture, and may require more conservation attention. As rural-urban interface continues to grow, agriculture and natural resource managers must integrate these findings if agriculture and natural resource based industries are to be seen as socially responsibly and environmentally acceptable.

c. **Source of Federal Funds** - Hatch

d. **Scope of Impact** – Multi-state

8. Key Theme: Forest Resource Management

(Reference OSU Plan of Work Extension Program 4G: Forest Resource Management)

a. **Description of Activity** - Emerald Ash Borer (EAB) continues to dominate the educational outreach for woodland owners in 2006. The bug has now been found in 26 of 88 counties, mainly in northwest, west and southwestern Ohio. Programming directed towards getting woodland owners to think proactively continue to dominate the schedule

2006 saw the addition of another tri-state programming opportunity for woodland owners. The Ohio River Valley Woodland & Wildlife Workshop was held in the Cincinnati area of Ohio. This workshop is a joint effort between Ohio, Kentucky and Indiana. Indiana will host the meeting in 2007. This first attempt at programming in this part of the state was successful with over 160 attendees

from all three states.

Another new program offered in 2006 was the Ohio Woodlands, Water & Wildlife Conference. This multi-discipline conference was targeted as an in-service opportunity for natural resource land managers – particularly those with park districts and soil and water conservation districts. This conference offered 3 concurrent sessions – themed as woodland, water and wildlife. This first attempt had over 120 attendees and they overwhelming indicated that they would like this to be an annual event.

The Ohio Woodland Stewards Program offered 26 classes along with its annual 3 editions of the newsletter Ohio Woodlands, Watersheds & Wildlife. In addition to the Woodland Stewards programming, 6 pesticide recertification sessions were taught, including both agricultural producers dealing with woody brush control and the commercial applicators dealing with forestry herbicide applications. The Tri-State Woodland & Wildlife Workshop was held again in cooperation with Indiana and Michigan – with Michigan being the 2006 host.

b. **Impact** - There were over 630 attendees to the 26 classes offered in 2006.

- Of the approximately 630 attendees, 75% of them were new to the program.
- 82% of the attendees of the Ohio Woodland Water & Wildlife Conference indicated that they would use the material offered in managing their own natural resources better.
- The 630 attendees own approximately 9000 acres of woodlands scattered across the state of Ohio.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** – Multi-state

9. Key Theme: Forest Crops

(Reference OSU Plan of Work Extension Program 4H: Forest Specialty Crops)

a. **Description of Activity** - Forest specialty crops, including maple products, Christmas tree, herbs, and tree fruits and nuts, offer income opportunities that often exceed typical commercial timber production. In Ohio both the Christmas tree and maple syrup industries are well organized and progressive. Both have commodity organizations, the Ohio Christmas Tree Association and the Ohio Maple Producers Association. A recent USDA-NASS report suggested that there were over 1000 commercial Christmas tree producers in Ohio. A recently completed survey estimates that there are over 600 commercial maple producers in Ohio, along with countless hobbyists producing syrup and confections for personal use. In both of these industries most of the entrepreneurs are part-time, and their earnings represent an important component of their annual income. Both industries represent several million dollars in annual sales – around five million dollars for the maple industry and approaching thirty million for the Christmas tree industry. Entrepreneurs in both industries are interested in maximizing profitability by improving their abilities to produce a quality product at the least cost, in evaluating the application of new production technologies, and

in developing and improving their marketing strategies. Less well-organized are the tree fruit and nut and the forest herb producers. Nonetheless, they are a clientele who are growing in numbers and in their desire to receive information and participate in OSU Extension programs.

b. Impact –

- 98 commercial maple producers in Ohio and 196 commercial maple producers in Michigan received in-depth training on various aspects of maple production through several workshops and presentations.
- 101 potential and small scale maple producers in Ohio received training on the fundamentals of maple product production and marketing.
- Several OSU Extension and non-Extension faculty completed an extensive survey of the Ohio maple industry to identify its demographics, production and marketing practices, and information needs. The results of this survey will be invaluable in developing future educational programming and publications to serve that industry. To date, the results have been disseminated at a variety of conferences and published or accepted for publication in a number of journals including the Journal of Forestry, the Northern Journal of Applied Forestry, and the Ohio Woodland Journal.
- The completely revised second edition of the North American Maple Syrup Producer's Manual was published by Ohio State University Extension in October, 2006. Leadership for the writing and editing of the manual was provided by Dr. Randy Heiligmann, a faculty member in the School of Environment and Natural Resources at Ohio State. This 329 page manual, containing 13 chapters and 5 appendices, serves as a primary reference for maple producers in the United States and much of Canada. Over 3000 manuals were sold by the end of 2006.
- 73 Christmas tree growers in Ohio received in-depth training on various aspects of Christmas tree production.
- OSU Extension personnel continued to strengthen participation in programs that address needs of other forest specialty crops by participating in programming of other organizations , including the Ohio Walnut Council and Rural Action.

c. Source of Federal Funds - Smith-Lever 3b&c

d. Scope of Impact - State Specific

Goal 5. Enhanced Economic Opportunity and Quality of Life

Executive Summary

For each one million dollars spent on research in Ohio, 32 jobs are created in the local economy. Those jobs in turn enhance the tax base and the overall quality of life. Thus the state and federal base or capacity funding, when combined with the extramural dollars generated for OARDC research, provide a significant boost to the economic opportunities in Ohio. These OARDC managed dollars contribute to the total $600 plus million-dollar research portfolio of The Ohio

State University. OARDC's research program is inextricably linked to a broad cross section of research activities in five OSU colleges, thus further leveraging its research dollars.

Included with this goal are economic actions related to development of a research park, carbon trading, a real estate pricing option model, and improved food safety. Rural–urban interface issues related to large-scale livestock operations and research impacts within the green industry are also discussed.

The Land Use Team has recently been active with workshops on the new state purchase of the development rights program that was funded by a $25 million state bonding initiative with a local match. In addition, the Ohio Department of Development had provided grants to nearly 60 Ohio counties to develop a farm preservation plan. Extension personnel were actively involved in recruiting and training members and assisting in the development of these plans. Additional assistance was given to the development and training of various planning commissions and in assisting in the comprehensive community planning process.

OSU Extension personnel served as the county's lead community economic development individual in four Ohio counties in 2006. Another individual served as the county's grant writer/coordinator. And, another served as the county's planning commission director. Eight other Extension CD professionals provided full time community and economic development programming to their respective county's constituents. All told, there were over 100 Extension professionals with full or partial Community Development responsibilities conducting community and economic development programming in Ohio in 2006.

In pursuit of an enhanced quality of life and increased economic opportunities, Extension programming takes a total community development approach. This approach takes into account human and leadership development, community infrastructure development (including support systems and physical infrastructure development) and economic development.

In the economic development strategies, the Business Retention and Expansion Program and Retail Market Analysis Program continued to be enhanced by the Department of Agricultural, Environmental and Development Economics. These flexible consulting programs assisted over a dozen local communities in 2006. Retention and Expansion Programs continued to be conducted for nearly all sectors of the economy and included industrial, agricultural, retail/service, and residential, in 2006. Additional assistance was provided in educational programs on enterprise zones, joint economic development districts, community reinvestment areas, revolving loan funds, and tax increment financing that led to over $20 million in new investment and 200 jobs. Assistance was also provided in attraction via industrial site development programming and community capture of local discretionary income.

Programs are also available for local leaders and government officials on wastewater treatment alternatives and water supply systems. Extension educators in several counties work closely with local groups in the creation and operation of revolving loan funds and the establishment of industrial parks. Some of the Community Development Educators conduct downtown revitalization programs and state route corridor development projects.

Community Leadership Development is a wide-ranging area that includes operation or assistance

of year-long leadership training programs. More ad hoc programs include training for members of non-profit boards of directors. Leaders are instructed in such programs as: appreciative inquiry, finding and mobilizing community assets, and Vision to Action. The Public Issues Team provides instruction on Framing of Issues, National Issues Forum (as per Kettering Foundation), and dispute resolution.

Tourism Development Programs are focused in the rural areas on heritage tourism. The Ohio Chautauqua Program has brought a renewed sense of pride in several counties as they participate in enrichment activities and rekindle an interest in historical events.

The Ohio 4-H Youth Development program provides positive environments for culturally diverse youth and adults to reach their fullest potential as capable, competent, caring and contributing citizens thus enhancing their quality of life. As a result of the Ohio 4-H positive youth development experience: youth develop marketable skills for lifelong success; youth participate in and learn through citizenship opportunities to transform local communities; youth appreciate and build upon diversity to foster a harmonious global society; youth have a sustained relationship with a caring adult to enable them to be productive citizens; and volunteers build their skills and abilities in working with youth.

Smith-Lever Fund expenditures for Goal 5: $5,128,612 FTE's: 77.1
Hatch expenditure for Goal 5: $357,607 OARDC FTE: 3.3

Goal 5 Key Themes

1. Key Theme: Economic Development

(Reference OSU Plan of Work Research Program 5A: Economic Development)

a. Description of Activities - The U.S. Department of Commerce has invested .75 million dollars in OARDC and OSU Extension's BioHio Research Park in Wooster, Ohio. The park, Pounden Technology Development Center, is an effort to more rapidly move research findings from the lab to the marketplace. The goal is to insure its research discoveries get into the hands of the user to enhance economic well-being and create jobs to benefit the people of Ohio.

The research park provides space for private companies developing commercial products and services resulting from university research, as well as for university work specifically oriented to commercial application. The work is an outgrowth of the Agricultural Technology Commercialization and Economic Development Program, geared to foster economic development from university research and programs that focus on food, agricultural, environmental, and life science technologies.

Occupants will either be start-up companies who see the benefit of being in close proximity to OARDC's resources, satellite offices of existing companies working with university researchers, or university-based workers connecting research to the market. The park is expected to attract companies working in areas including plant and animal disease detection and prevention; biomass conversion

for energy, specialty chemicals, lubricants and polymers; and food production, safety and packaging.

Economic development can also be found in carbon farming. Farmers who practice no-till or any other tillage-limiting production technique can earn additional dollars by carbon trading - the latest push for a greener environment that rewards growers who sequester, or keep carbon in the soil.

Carbon trading efforts have been expanding across the United States and involve energy industries paying no-till farmers through bilateral agreements, or agricultural groups working in the open market on farmers' behalf. In 2006, carbon was trading at $1.70 per ton of carbon dioxide, which roughly translates into one U.S. dollar per-acre of revenue for participating Ohio farmers.

OARDC's Carbon Management and Sequestration Center leads education and research efforts to ignite working relationships between Ohio farmers and the state's energy industries. The challenge is to enlist no-till farmers to seek out carbon trading opportunities and convincing tillage farmers to adopt conservation tillage practices. To foster such trading, OARDC scientists have created an Ohio county-by-county database documenting the rate of carbon sequestration based on soil type. These data are necessary for carbon trading to occur, improving the financial condition of the farm community.

Economic activity and growth is also tied to farm real estate. Farm real estate values and cash rents are important indicators of the financial condition of the farm sector. Real estate comprises a substantial share (85%) of the farm business assets, and over 50% of farm business debt comprised of real estate debt. Farm real estate values are influenced by net returns from agricultural production, capital investment in farm structures, interest rates, government commodity programs, property taxes, and non-farm demands for farmland. Accurate models are crucial to efficiency of rural land markets.

An emerging model, real option pricing, suggests that an important component of real estate market prices may be the option value derived from future cash flow uncertainty. Hence this new option pricing approach, as opposed to its standard conventional counterpart in finance, incorporates both the uncertainty about the future net benefits of a selling decision and the irreversibility of this action taken. Data for a random sample of agricultural parcels in Ohio were used, and the impacts of urban development on agricultural real estate markets, are estimated. Results indicate that real option pricing theory is successful in explaining the effects of development on market values and current cash rents.

On another economic front, OARDC scientists are addressing the economic value of improved food safety. In a nationally representative U.S. mail survey (49 percent response rate) in 2006, they studied 1) respondents' opinions about the safety of foods prepared at home; 2) respondents' prior knowledge of pathogens; 3) respondents' opinion of the safety of either ready-to-eat hotdogs or raw hamburger; 4) respondents' household's experience with food borne illness from foods prepared in their home; 5) how respondents prepared food for themselves and their household, in general, as well as how they handle and prepare either ready-to-eat hotdogs or raw hamburger; and 6) how habits may change when foods treated to decrease the amount of germs in the food become

available. Specifically, respondents were asked to choose among competing hypothetical products (either hamburgers or hotdogs) where some products were processed using technology (electron beam or ethylene gas treatments) aimed to reduce the risk of food-borne illness caused by a particular pathogen (either *Listeria* or *E. coli*). A hypothetical government-sponsored food safety program was presented to elicit respondents' willingness to pay for the program.

b. **Impact** - BioHio Research Park has a number of partners who are expressing interest in setting up office at the research park. One company currently having a research partnership with OARDC on several projects, including development of a children's product to ease lactose intolerance, will become the first occupant. According to the latest government rankings, Ohio State is ninth in research expenditures among public universities and is sixth in industry funding among all U.S. research universities. Such park is warranted.

The research park builds on the need to serve our commercially focused industrial partners. This Wooster, Ohio based park is in addition to other Ohio State's commercialization efforts; Ohio State University already houses 43 companies on the Columbus (Ohio) campus and has received more than $16 million in venture capital. Ohio State currently earns $589 million in externally funded research. The impact of investments by federal, state, business partners, and the university provide an opportunity to all to take full advantage of university research to commercialization value chain.

OARDC scientists have created a database for Ohio that will make carbon trading possible, and garner added economic return. They also contend that carbon trading is not only an important marketing practice for Ohio growers, but has implications for solving some of the world's most pressing food security problems. According to OARDC soil scientists who are focusing on soil quality in such locales as the United States, Africa, India, South America, and Latin America, if soil carbon content was increased by one ton per hectare (roughly 2,000 pounds per 2.5 acres) using carbon sequestering conservation practices, grain yield would increase 220-440 pounds per 2.5 acres, wheat yield from 44 pounds to 110 pounds per 2.5 acres, and soybean yield from 44 pounds to 88 pounds per 2.5 acres.

Countries like Asia and sub-Sahara Africa food deficit will be 22 million tons by 2010. If farmers adopt carbon-sequestering practices, food production could increase by 32 million tons every year, basically eliminating that food deficit. While shifting to practices that store carbon has a monetary cost, funds generated from carbon trading can offset these costs. Within the United States, carbon trading based on existing and potential to adopt no and low tillage options have economic return potential far above costs to maintain or convert to these new practices.

OARDC scientists are also showing through their economic modeling that where there is high prospect of land use conversion from agricultural to other uses arising from urban development, the land's implicit call option tends to increase in value, reflecting future land price increases due to uncertainty. This is realized through the mechanism of increasing cash flow/rent volatility. An increasing volatility, in turn, translates into a tendency towards an increasing real option value. An emerging theory, real option pricing, suggests that an important

component of real estate market prices may be the option value derived from future cash flow uncertainty. Hence this new option pricing theory, as opposed to its standard conventional counterpart in finance, incorporates both the uncertainty about the future net benefits of a selling decision and the irreversibility of this action taken. This model informs agricultural real estate decision theory.

When addressing the economic value of improved food safety, OARDC scientists reported that introducing a new food-safety technology may cause some consumers to choose foods processed with new technologies while also driving others consumers to stop buying the food altogether. If producers provide consumers both treated and untreated product, then the act of providing treated foods may actually lead to aggregate losses in sales. This may explain firms' reluctance to adopt these technologies. Unless consumer concerns toward these technologies can be allayed, the population may face higher food-safety risks. Overall, the results concerning consumers' willingness to pay for reductions in the probability of food borne illness is being used by policy makers and analysts at the U.S. Department of Agriculture and the U.S. Centers for Disease Control and Prevention for policy planning purposes.

c. **Source of Federal Funds** - Hatch

d. **Scope of Impact** - State Specific

2. Key Theme: Rural/Urban Interface

(Reference OSU Plan of Work Research Program 5Br: Rural/Urban Interface)

a. **Description of Activities** - Animal production has made a shift toward large-scale and more concentrated operations to meet society's increasing demands. The livestock industry is facing significant hurdles as a result of increasing public concern about odor, and about gaseous and particulate emissions from animal operations. Some large operations are already experiencing lawsuit challenges—in one recent case, part of a final settlement totaled more than $50 million. Extensive literature reports have documented acute and chronic respiratory disease and dysfunction among swine and poultry workers—exposure costing millions in medical bills and lost production, and priceless amounts in quality of life.

Concentrated animal feeding operations generate potentially significant levels of aerial pollutants such as ammonia, hydrogen sulfide, methane, carbon dioxide, odor, and dust. Ammonia and hydrogen are harmful to human and animal health. Odor creates a nuisance for neighbors, and dust particles carry odor, bacteria, and viruses that may be transmitters of disease. Air emissions from animal-feeding operations are affected by many factors, including geographical location, climate and weather conditions, topography, animal species, facilities, farm layout, and management practices.

OARDC scientists are focused on both indoor and outdoor air quality to account for human worker and animal health and air dispersion into neighboring communities. Currently, no standard test methods exist for monitoring aerial pollutant emissions and air quality of animal farms. There is also very limited

information on air emissions from animal feeding operations and effective mitigation solutions. According to the newly announced EPA air quality compliance agreement with animal feeding operations, the livestock and poultry industries are facing a significant challenge to manage the aerial pollutants and comply with the federal air quality laws. Management practices, while important, must be coupled with the development of mitigation technologies to reduce aerial pollutant emissions to levels specified by federal air quality laws.

b. **Impact -** Short-term air quality and emission information from six typical Ohio farms—two dairy facilities, one egg-laying facility, and three swine farms—were collected. OARDC and OSU Extension scientists use their air quality and air emission information to develop a fact sheet to educate Ohio livestock and poultry producers on the air emission levels of a typical Ohio farm. The fact sheet has proved to be very helpful for producers in making decisions about signing the EPA air quality compliance agreement with animal feeding operations. This agreement is having a profound impact on the livestock and poultry industry.

A secondary impact from this study was a .5 million dollar USDA grant to OARDC to develop mitigation technologies. Equally as important is a matching grant from an industry partner. The investments by federal, state, and industry partners further illustrate commitments of all parties to leverage base funding through collaborations.

c. **Source of Federal Funds** – Hatch

d. **Scope of Impact** – State Specific

3. Key Theme: Green Industry

(Reference OSU Plan of Work Research Program 5C: Green Industry)

a. **Description of Activities -** For Ohio and the nation to maintain competitive in green industry production, greater efficiency is required. Weed control is the largest expense faced in the nursery and landscape industries. As a result of weed competition, growth, and aesthetic value of the crop or landscape plants are reduced. Nursery growers may spend $967 to $2,228 per acre for supplemental hand weeding over and above herbicide application costs. Economic losses due to weed infestations when no herbicides were used have been estimated at approximately $7000 per acre. Pre-emergent herbicides are commonly used to reduce these hand weeding cost and economic losses.

Woody plant death is a major economic loss. Above ground killing in woody plants is likely the result of root-killing and the destruction of many absorbing organs of the plant. Also the impact of root inhibiting herbicides on root and shoot cold hardiness and regrowth after over-wintering is of interest to many nursery growers. Selection of cultural practices such as what herbicides do not reduce hardiness is essential to the economic survival of nurseries and landscape operations in these states. Methods that would decrease possible stock losses and delays in plants reaching marketable sizes due to cold injuries and improve landscape tree performance and survival are of significant economic importance to growers, landscapers, and retailers.

b. **Impact -** For Ohio, the green industry represents $5.9 billion in output and accounts for almost 80,000 jobs, ranking the state fifth and fourth in the nation respectively. Woody plant growth, pre-emergents, and winter root kill are linked and part of this economic driver. Although the pre-emergents increase growth, OARDC research demonstrates that they also increase the incidence of winter injuries and mortality and reduce re-growth potential. The economic importance of increased growth using an herbicide application on some species may be negated by the increased susceptibility to cold injuries. As a result of this study, industry partners funded a separate study to investigate the influence of several commonly used pre-emergent herbicides on several species of field grown trees.

c. **Source of Federal Funds** – Hatch

d. **Scope of Impact** – State Specific

4. Key Theme: Quality of Life

(Reference OSU Plan of Work Research Program 5D: Quality of Life)

a. **Description of Activities** - OARDC scientists have examined welfare reform's impact on rural families as part of a 10-year national study, beginning in 1998. They found that most participants live much more complex lives than 'anyone with a standard job can imagine, juggling work schedule changes and child-care arrangements and living under the constant stress.

The study corroborated evidence of the unique nature of the rural poor. For example, they often have work schedules that vary from day to day and week to week, and work that involves very early hours, second or third shifts, and weekends. Likewise there is typically no day-care centers providing care at the times needed, and the variability in shifts makes it challenging to schedule child-care arrangements. Most of the working mothers in the study used friends or family members as child-care providers, and those arrangements were not always reliable. Mothers reported having to have two or three back-up providers for emergencies.

Incomes that vary on a weekly basis caused many mothers to juggle bill paying and spend an inordinate amount of time trying to find bargains. Additionally they often pay higher food costs at nearby stores because of the cost of — or lack of — transportation. Their cars often had a great deal of maintenance problems making them unreliable. Finding alternative transportation to work was an additional challenge.

Physical, mental, or dental health problems were reported to go untreated because of lack of insurance coverage, the cost of health-care treatment, and a lack of providers in the community who take Medicaid patients. Likewise many were found not to have sick leave as a job benefit, thus they have difficult decisions regarding missing work when they or their children are sick. Although many want full-time work, they often cannot find it locally.

Economics challenges within many school districts often prevent students from taking full advantage of all educational opportunities. OARDC has made science more exciting for Ohio K-12 students by offering different hands-on

educational programs on its Wooster campus. Many schools though have not been able to take advantage of OARDC's educational activities because of budget cuts. Thus OARDC researchers had to find another way to bring science to life for these students.

In the past year or so, more and more teachers and schools who have made a yearly trip to OARDC's Wooster campus for one of our special events or just for a class tour or field trip have had to cancel their visits because of funding constrictions. The question became how could we continue to meet their needs and get these students excited about the opportunities in the agbiosciences?

b. **Impact** - Recommendations that were generated by the study of the working poor to date to help improve both the quantity and quality of life are to: 1)encourage more businesses to offer sick leave, 2) provide more opportunities for advancing education, 3) extend access to health insurance, either through employers or by expanding government-sponsored programs, and broaden access to mental health care, often not available in rural areas, 4) provide some type of public transportation, 5) find ways to support family members who assist low-income parents day-to-day, or at least do more to publicize programs already available, 6) consider the benefits a higher minimum wage could have on low-income families, or expand the Earned Income Tax Credit. Each of these recommended changes would have dramatic impact on an underserved segment of our society.

School access to science enrichment activities is a concern of OARDC. Schools are short on money for anything extra such as field trips and expert speakers. Thus teachers often turn to organizations like OARDC for free specialists who will engage the science students in activities that bring understanding. OARDC decided that if students could not come to the OARDC Wooster campus for a science experience, OARDC would take science to them via *OARDC on the Road*, a pilot program that started in the winter of 2005-06. Schools with limited field-trip opportunities were encouraged to submit applications to have OARDC bring a hands-on science learning experience to their classrooms.

In its first year, the program reached more than 800 elementary and junior-high students from different types of schools — from urban schools in Mansfield (with 100-plus students per grade) to schools such as Winesburg Elementary (with only 15 students in its entire sixth grade) — who learned about the science of pollination, soybeans, coyotes, and watersheds. Teachers documented and reported the benefits this outreach effort provides by enhancing their pupils' science curricula. The 2005 -06 program was so successful that OARDC plans to visit 24 schools during the 2006-07 school year.

c. **Source of Federal Funds** – Hatch

d. **Scope of Impact** – State Specific

5. Key Theme - Jobs/Employment

(Reference OSU Plan of Work Extension Program 5E: Community Economic Well-Being)

a. **Description of Activities** - The Community Development Program Area's work in economic development issues centers on working in partnership with community elected and appointed officials, development officials, Chambers of Commerce, and other economic development organizations, committees, and boards to create economic opportunities and enhance economic conditions. Statewide, fifteen full-time Community Development Educators, five Program and Research Assistants and many dual-program Extension Professionals contribute to this effort focusing on the following programs: tourism and byway development, business and residential retention & expansion, retail market analysis, business incubation and attraction, downtown market analysis and downtown revitalization, economic impact analysis, small business planning and human resource management, financial planning, tax incentives and community business loan programs, community foundation development, and job preparation skills. Facilitation and assistance to local economic development-related boards and committees is also a program area focus.

b. **Impacts** - Educators reported assisting local communities in the direct creation or retention of over 300 jobs. One community's BR&E program is directly responsible for the expansion of over 1200 jobs since 2003. Between 2004-2005, the business development program assisted 1269 business clients involving over 10,000 hours of one on one assistance. Eighty training sessions were conducted involving 1770 participants and 8842 training hours. These businesses created 1300 new jobs, retained over 20,000 existing jobs, acquired nearly $14 M in loans and invested nearly $12 M in equity. Over $53,000,000 in new property investment was facilitated via local economic development assistance, downtown revitalization efforts, and management of local tax incentives programs. One community was able to facilitate the expansion of a local business by making a $490,000 loan from their local RLF. Another secured grant funding of $500,000 for downtown revitalization, and a third was awarded a $500,000 grant to leverage the construction of a 50,000 sq ft speculative building. Another secured $737,000 for a natural gas line extension into an Appalachian industrial park. As a result of local program efforts, $3.8 million was awarded for transportation feasibility studies and roadway construction to facilitate job growth.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

6. Key Theme: Community Leadership

(Reference OSU Plan of Work Extension Program 5F: Community Development)

a. **Description of Activities** - Classes are given for newly elected and appointed local government officials who often take office without the benefit of either formal leadership training or practical leadership experience commensurate with the responsibilities they assume once in office. Volunteers, who do not see themselves as leaders, are trained on the principles of leadership and take positions of responsibility. Business owners and non-profit leaders are given education on ethics, dealing with the media, conducting effective meetings,

working with citizens, building sustainable communities, team building, conflict management and resolution, leadership talents, leadership styles and skills, effective decision making, time management, creativity, etiquette, relationship building, principles of leadership, dealing with negative people, Roberts Rules of Order, intergovernmental relations, technology in local government, holding large group meetings, leading with integrity, making strengths based change in communities and organizations, discovering and building on community and organizational assets, creating a shared community vision, and regionalism.

Many elected officials ultimately learn their job by doing it in an almost swim or sink method. To support current office holders and prepare potential office holders Extension Educators and Specialists have developed a number of Local Government Leadership Academies. These Academies help participants gain leadership skills, an ability to understand and use a variety of community planning and change methods, and an awareness of issues important to the local community.

Extension Educators and Specialists have also created and/or support local Community Leadership Programs which train volunteer, non-profit, and sometimes elected and appointed officials. The programs include large system change processes such as Appreciative Inquiry, Vision to Action, Public Deliberation, Future Search, Asset Based Community Development, and Citizen Engagement through the 21st Century Town Meeting. Participants also learn small group processes that focus on Team Development.

b. **Impact** - 2074 participants participated in the leadership programs provided by Extension Educators in 2006. The participants report that the programs have helped them hone their current leadership talents as well as add new capacity to their leadership skill set. The Local Government Leadership Academy participants indicated a greater awareness of their responsibilities and legal requirements for discharging their duties, and increased knowledge regarding technology issues for communities, and regional planning duties. The education in large system change processes has given some areas of the state the ability to initiate regional development programs.

The Appreciative Inquiry and Team Development training created new levels of confidence in Community Leadership Program participants. Bolstered by their new knowledge and in class group leadership experiences program participants have reported running for and winning elected office. Participants have also increased their level of volunteerism within their communities.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

7. Key Theme: Sustainable Development

(Reference OSU Plan of Work Extension Program 5F: Community Development)

a. **Description of Activities** - The OSU Extension Sustainable Development Center (SDC) was created in 2006 to recognize the growing success of Community Development's initiatives in sustainable visioning and planning. The SDC is a

virtual operation that integrates educational program resources that focus on linking entrepreneurship, workforce enhancement, community capacity building, the green industry, technology transfer, regional sustainability and the food economy into a holistic approach to reach sustainable community goals.

b. **Impact** - The SDC is engaged in community comprehensive planning programs with one city, Salem, and one county, Marion, generating over $22,000 in cost recovery dollars. The inclusionary citizen participation process curriculum created for the City of Kent by the Sustainable Development Team won innovative design awards from the International City Managers Association and the Ohio City Managers Association. This same process was recognized for its innovation and the City of Kent and the SDC Team were invited to present this approach to the Innovation Group's annual national conference for cities throughout the U.S. Additionally, the team completed visioning processes and produced Sustainable Vision reports for two additional communities, West Chester, the fastest growing township in the state, and the Swanton Region, including two townships and one village in two counties.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

8. Key Theme - Financial Management

(Reference OSU Plan of Work Extension Program 5G: Management of Economic Resources)

a. **Description of Activities** - Individuals and families who are facing challenges to present and future economic well-being and overall quality of life come in all ages, geographic regions, ethnic groups, and economic strata. Throughout Ohio in 2006 county educators were sensitive to these challenges for families in their communities. Many Ohio families faced threats to their economic well-being and quality of life. For some individuals, the loss of good-paying jobs with benefits has greatly affected families and their respective communities. For others it was declining health concomitant with inadequate or non-existent health insurance that threatens. Others were faced recovering from bankruptcy and/or home foreclosure.

County Extension educators sought to help families assess their financial circumstances, increase their financial management skills, and develop their decision-making abilities to improve both present and future economic well-being. They did this through face-to face instruction with individuals and families, training of professionals such as teachers and social workers who work directly with individuals and families, and through social marketing and distance education. The distance education took place via correspondence 'courses' (sometimes called letter studies), and social marketing used television, radio, and newspaper media, and county Extension web sites. Contact and related knowledge gained through social marketing campaigns is difficult to measure. The eXtension Financial Security for All Community of Practice will add greatly to OSU Extension's web presence and educational opportunities in financial

management in 2007.

There were two main emphases, overall, in the financial management programs offered in 2006. They were basic financial management skills and planning/working for financial security in retirement. The basic financial management skills involved determining/prioritizing goals, organizing financial records, tracking spending, establishing a spending plan and decreasing spending, improving bill paying and reducing debt, and beginning or increasing savings.

b. **Impact** - Many Ohioans made progress in their financial management skills and behavior as a result of participating in Extension programs. Overall, more that 20,522 participants learned new information in financial management programs provided by Ohio Extension educators. In addition, many had made more explicit plans or had begun specific behaviors:

- 18,205 planned to utilize recommended financial practices
- 3228 utilized recommended financial practices
- 1364 planned to develop a strategy to reduce debt
- 1157 reduced total debt
- 2265 planned to use specific goals to guide financial decisions
- 1468 did use specific goals to guide financial decisions
- 1023 organized or improved organization of the financial records
- 2456 planned to make better spending decisions
- 1224 reported improved spending habits
- 1489 planned to set aside money for unplanned expenses
- 1107 set aside money for unplanned expenses
- 1141 set aside money for occasional expenses
- 1317 improved bill paying

The Debtor Education Program for bankruptcy filers that is directed by the U.S. Department of Justice approved OSU Extension as a provided for in-class education. During 2006, OSU Extension educators taught classes for 90 participants. Specific planned behaviors that were expressed by the 90 participants AFTER participating in the program are listed:

- 98% planned to use the information from the program
- 97% were confident that they could make recommended changes
- 78% planned to change behavior within 1 month
- 100% planned to use goal to guide financial decisions
- 97% planned to pay bills on time
- 96% plan to set aside money for unplanned expenses
- 98% planned to save money toward a goal
- 100% planned to match income to spending
- 99% planned to spend wisely

Planning for a future of economic well-being and enhanced quality of life was a focus of the financial management education that occurred in 2006. Most of the programs fell under the rubric of Financial Security. Specific behaviors related to longer-term financial security are listed below:

- 2186 planned to adopt recommended financial practices
- 843 adopted recommended financial practices
- 2169 planned to start saving toward a goal
- 1302 increased savings

- 153 planned to determine retirement needs
- 156 planned to establish retirement goals
- 127 planned to start or increase contributions to employer-provided retirement plans
- 153 planned to develop a plan for managing long-term health care
- 127 planned to develop an integrated plan for achieving financial security

c. **Source of Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

9. Key Theme – Land Use Issues

(Reference OSU Plan of Work Extension Programs 5H: Land Use Issues)

a. **Description of Activities** - During calendar 2006 Extension Educators and Specialist assisted public officials, community leaders and the general public with various land use issues throughout the state. Educational workshops were held on Comprehensive Land Use Planning, Subdivision Regulations and Zoning Basics, Sustainable Land Use Planning, Regional Sustainability and Watershed Planning among others. The OSU Extension Land Use Team members were asked to teach land use education sessions at the Ohio Auctioneer's Association Annual Conference, the Ohio Township Trustee's Association winter and summer meetings along with sessions that were held at the Ohio County Commissioner's Association annual meeting. The OSU Extension Land Use team also conducted an annual Land Use Conference targeted to elected and appointed officials throughout the State. Eighty-five appointed and elected officials participated in the day long event.

b. **Impact** - Attendance at the various sessions mentioned above totaled over 3,000 people. The Existing Land Use Tools Subcommittee of the OSU Extension Land Use Team continues to provide training for residents and officials throughout Ohio at community preferred locations. Of particular interest is the program that is offered to Hamilton County Realtors which is provided at a location in the major urban area of Cincinnati. The program provides 109 hours of continuing education credits for real estate and development professionals. Another location of interest is at the Knox, Morrow and Richland, Tri-County Newly Elected and Appointed Public Officials Institute. Fifty newly elected and appointed public officials in this area of north central Ohio have received land use education programs as part of this annual program.

The on going development of comprehensive land use plans in Huron and Marion County continues. During 2006 Land Use Team Members completed work on land use plans in Wyandot County, The City of Salem in Columbiana County, and Columbia Township in Lorain County. Work on the Morrow County Zoning Resolution continues and work began on a comprehensive land use plan and an update to the zoning resolution for Wellington Township in Lorain. The uniqueness of Extension Land Use Planning methods is the inclusionary participation of citizens. This priority has met the participation of nearly 1200 citizens in determining their community's future.

c. **Source of Federal Funds** - Smith-Lever 3b&c
d. **Scope of Impact** - State Specific

10. Key Theme - Tourism

(Reference OSU Plan of Work Extension Program 5I: Business Efficiency)

a. **Description of Activities** - Tourism development is one major focus of the Ohio community economic development program. Tourism is important in Ohio with over ten billion dollars in primary economic activity. The Extension Tourism Team is in transition with the retirement of a key tourism leader from southeast Ohio in mid 2006 and the hiring of a new extension tourism professional for the Lake Erie region late in 2006. This new hire is a partnership of OSU Extension, Ohio Sea Grant and Lake Erie Coastal Ohio, Inc. Over 340 individuals involved in tourism were reached through Extension Tourism efforts. Topics involved included: advancing community tourism, the importance of a sense of place, tourism marketing and advertising, and Amish Country tourism. Presentations were made at public forum organized by Congresswoman Marcy Kaptur (Toledo), National Appalachian Studies Conference (Dayton, OH), National Extension Tourism Conference (Burlington, VT.) and in workshops in Holmes County, OH and other southeast Ohio Counties. The Extension Tourism Director is the President of the Ohio Tourism Association and the chair of the America's Byways Resource Center Committee on Scenic Byway Impacts.

b. **Impact** - Work with Scenic Byways continues to be the focus of several Extension Educators. The Amish Country Scenic Byway can trace increased revenue since its designation. Educational programs (fall foliage and agri-tourism tours) and a marketing plan have been instrumental in making this happen. The Lake Erie Coastal Ohio Trail received state and federal designations in 2005, thanks to significant work by Extension personnel. Still other Extension Educators are working with more localized scenic byway designations which provide opportunities for educational programs about tourism as well as technical assistance.

Extension Tourism Program Director is leading the Ohio Tourism Association (OTA) in developing a strategic plan and an OTA effort to gain increased tourism marketing support from the Ohio legislature with a Report on the Potential Impact on Tax Revenues from Increased Tourism in Ohio. Chautauqua-Gallipolis was huge success with the largest number of participants in the educational sessions. The planning committee is well on the way towards the fund raising goal to conduct the Chautauqua- Gallipolis program in 2008. Fall foliage, agritourism and scenic byway tours organized by OSU Extension attracted thousands introducing visitors to rural Ohio. Two years following an agritourism marketing campaign led by OSU Extension, tourism in Galia County increased 66% (Ohio Department of Development, 2006.) Extension professionals lead Holmes County and Lake Erie Coastal Ohio Scenic byway tourism efforts. Fifteen business owners, the Amish Country Management Comm, and public officials increased their awareness and knowledge of Ohio Scenic

Byway ODOT signage regulations affecting 'billboard' requests along the Amish Country Byway and used the information to make decisions concerning billboard requests on the scenic byway. Scenic Byway signage was placed on the Lake Erie Coastal Ohio Trail by the Ohio Department of Transportation. Ohio citizens learned more about Lake Erie tourism, culture and history from the highly rated WGTE (PBS Channel 20, Toledo) documentary, *Lake Erie –Ohio's Great Lake*, the publication of 10,000 Lake Erie Facts fact sheets and the publication of 100,000 Lake Erie Lighthouses and Maritime Adventures brochure.

c. **Source of Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

11. Key Theme - Aging

(Reference OSU Plan of Work Extension Program 5J: Work/Life/Health Issues)

a. **Description of Activities** - Nineteen (19) county Extension units submitted reports on efforts to: 1) increase awareness of aging, health, and consumer issues; 2) improve the quality of life for older adults and those who care for them; 3) increase awareness of services and resources of older adults in their counties; 4) provide support for the widowed and grandparents raising grandchildren; and 5) encourage stronger interpersonal relationships. Four issues of the Senior Series Hotline Newsletter, a product of the collaboration between Ohio State University Extension and Ohio Department of Aging and Ohio's Aging Network, were created and distributed to senior citizens, their families, and other aging-related social service organizations throughout the state reaching 5,732 households. The Universal Design website received 8,249 visits and the Life Planning: It begins with communication curriculum was downloaded 956 times. Ninety volunteers contributed 720 hours of their time, valued at $12,377.

b. **Impacts** - Seven thousand, five hundred eighty (7,580) individuals where reached with educational messages. Seven thousand, one hundred eighty-two (7,182) attended educational sessions. Of those, 52% (3,731) indicated they had learned new information and 39% (2,831) planned to adopt one or more recommended practices. When follow-up contact with program participants was made and the question asked, 2,073 individuals indicated they had actually adopted one or more of the recommended practices they had learned.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

12. Key Theme - Child Care Provider Training

(Reference OSU Plan of Work Extension Program 5J: Work/Life/Health Issues)

a. **Description of Activities** - Twenty-one (21) county Extension units submitted reports on efforts to: 1) assist new providers in becoming locally certified with the county Department of Job and Family Services; 2) improve existing child care

providers' skills and maintain certification; and 3) increase knowledge, skills, and application of developmentally appropriate child care practices to provide safe and nurturing environments for children. The Knowing Children on-line newsletter website received 7,225 visits. One hundred eighty-three volunteers contributed 1,465 hours of their time, valued at $25,166.

b. **Impacts** - Four thousand, eight hundred twelve (4,812) child care providers where reached with educational messages. Four thousand, six hundred thirteen (4,613) attended educational sessions. Of those, 90% (4,131) indicated they had learned new information and 53% (2,451) planned to adopt one or more recommended practices. When follow-up contact with program participants was made and the question asked, 1,646 individuals indicated they had actually adopted one or more of the recommended practices they had learned.

c. **Source of Federal Funds** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

13. Key Theme: Leadership Training and Development

(Reference OSU Plan of Work Extension Program 5K: Positive Youth Development)

a. **Description of Activities** - To become productive and contributing adults, youth must develop positive leadership knowledge, attitudes, skills, and aspirations. The purpose of State 4-H Leadership Camp is to enable teen participants to become better leaders and to achieve the following objectives:

- develop collegial leadership knowledge, skills, and attitudes
- contribute leadership in groups to identify & achieve goals and earn support
- develop leadership skills such as envisioning, consensus-building, group building & recognition
- realize the degree of control they have over their lives
- are encouraged to take the initiative to try new things and not be afraid of failure or success
- gain in physical, intellectual, emotional and social development
- gain ideas & methods to improve their clubs, communities, country & world
- develop new friendships
- provide real leadership in committees, leadership groups, & cabin groups, and
- have fun

Farm Bureau and Nationwide provide all program costs and scholarships for two teens from each of Ohio's 88 counties to participate in the camp each year. In addition, a small number of campers and staff from other states and countries are involved to provide a cross-cultural dimension.

State 4-H Leadership Camp is built on 10 research-based principles for effective youth leadership development. It: a) is built around specific leadership development purposes and goals, b) encourages high expectations and confidence in teens and demonstrates respect for teens, c) emphasizes experiential learning and involves teens in exercising genuine leadership, d) teaches teens history,

values, and beliefs of U.S. society, e) promotes awareness, understanding, and tolerance of other people, cultures, and societies, f) involves teens in collaborative experiences, teamwork, and networking with peers, g) helps teens develop specific skills related to leadership, h) involves teens in significant relationships with mentors and positive role models, i) facilitates the development of individual strengths and personal characteristics, and j) involves teens in service to others, their community, their country, and the world.

The campers themselves are responsible for deciding, planning, conducting, and evaluating almost everything that occurs at the week-long camp. In doing so, they develop real-life leadership knowledge, skills, attitudes and aspirations and achieve the other objectives and purposes. The only things planned before camp begins are meal menus, three to four hours of daily leadership workshops, the camp objectives and theme, and seven "given" behavior expectations.

When campers arrive at Camp Ohio they divide into program planning committees, leadership groups, cabin groups, and a variety of other committees and work groups. With others in their groups, campers plan, conduct, participate in, and evaluate everything else that happens during the week-long camp including the camp behavior guidelines and all the major programs and events which take place at camp.

The in 2006 State 4-H Leadership Camp was very highly evaluated and successful in achieving the leadership development objectives for which it was designed.

b. **Impact** - To evaluate the degree to which the purposes and goals of State 4-H Leadership Camp are met each year, participants are asked to complete written evaluation instruments at the conclusion of the program. Campers are asked to:

- rate the degree to which the camp objectives were reached,
- provide information about whether or not Leadership Camp made a difference to them and how,
- make recommendations for future State 4-H Leadership Camp programs, and
- provide basic demographic information.

Usable responses were received from 89% of the 2006 Leadership Camp participants (n = 108 of the 123 campers, counselors, and staff who participated in the 2006 State 4-H Leadership Camp). Content validity for the instrument was established through a review of literature and a panel of experts. Reliability was established using Cronbach's Alpha at .94. Data were analyzed using the SPSS 14.0 for Windows statistical program. Independent Samples T-tests were performed and revealed few significant differences in results due to gender, 4-H projects completed, or leadership positions held. Therefore, the evaluation results may be generalized to all 2006 4-H Leaders.

1. <u>State 4-H Leadership Camp was rated very highly overall, and all objectives were achieved.</u>

Evaluation results are outlined on the table below (scale: 7=strongly agree/excellent to 1=strongly disagree/very poor):

	Mean	SD

	Mean	SD
Overall Evaluation of State 4-H Leadership Camp		
Item: Overall, how would you rate State 4-H Leadership Camp? (n=108)	5.9	.89
Evaluation Ratings of Achievement of Leadership Camp Objectives		
Items: As a result of participating in this camp, campers...		
...improved their leadership abilities (n=108)	6.1	1.1
...gained skills & abilities for working and contributing leadership as part of a group (n=107)	6.2	.88
...contributed leadership in helping groups shape & achieve goals and gain support (n=107)	6.2	.93
...developed leadership skills such as consensus-building, negotiation, perspective-taking, public relations, group building and recognition (n=106)	6.1	.93
...better understood that they are in control of their lives, and can control their lives (n=106)	6.0	1.2
...were encouraged to take initiative to try new things and not be afraid of failure or success (n=104)	6.3	1.0
...gained in physical, intellectual, emotional and social development & became more competent, caring and contributing individuals (n=106)	6.1	1.1
...gained ideas to improve their clubs, communities, country & world (n=106)	6.2	.99
...provided real leadership in committees, leadership groups & cabins (n=107)	6.3	.87
...had fun (n=108)	6.4	.75
...made new friends (n=108)	6.7	.57

2. <u>Leadership Camp Made Positive Impacts On Camper Leadership Development</u>

To evaluate the extent to which Leadership Camp impacted campers' leadership development, participants were asked to rate themselves at the beginning and end of the camp, using a 7-point scale (7=Excellent, 6=Very Good, 5=Good, 4=Average, 3=Below Average, 2=Poor, and 1=Very Poor).

Results show that Leadership Camp significantly impacted campers' perceptions of their leadership development in every dimension measured, and that the camp was successful and effective in enhancing youth leadership development.

Personal Characteristic / Leadership Dimension	Mean Rating Before Camp	Mean Rating After Camp	Sig.
a. Ability to control my own life and manage my time	5.3	6.0	.000*

Personal Characteristic / Leadership Dimension	Mean Rating Before Camp	Mean Rating After Camp	Sig.
b. Initiative to try new things and not fear failure or success	5.0	6.1	.000*
c. Skills and abilities in leading groups	5.3	6.2	.000*
d. Level of self-understanding	5.2	6.0	.000*
e. Communications abilities	5.3	6.2	.000*
f. Interpersonal skills / abilities in working with others	5.7	6.3	.000*
g. Respect for myself and others	5.8	6.3	.000*
h. Trustworthiness	6.0	6.4	.000*
i. Responsibility	5.9	6.3	.000*
j. Fairness	5.9	6.3	.000*
k. Caring	6.0	6.4	.000*
l. Citizenship	5.8	6.3	.000*
m. Overall maturity	6.0	6.4	.000*
n. Ability to contribute to community, country & world	5.7	6.3	.000*
o. Quantity and quality of friendships	5.7	6.5	.000*
p. Ability to have fun in a positive way	6.0	6.5	.000*

b. **Source of Federal Funding** - Smith-Lever 3b&c
c. **Scope of Impact** - State Specific

14. Key Theme: Youth Development/4-H

(Reference OSU Plan of Work Extension Program 5K: Positive Youth Development)

a. **Description of Activities -** In Ohio; 89,890 youth participated in organized community clubs; 137,816 youth participated in special interest and day camp programs; 16,287 youth participated in resident camps, and 74,204 youth participated in school enrichment opportunities in 2006.
b. **Impact -** 4-H youth participants enrolled in over 375,997 individual projects and programs as a result of their involvement. Youth participated in a variety of

educational clinics and in-services to increase their subject matter and life skill development. Ohio was also a part of the national 4- H Impact Assessment project. In general, youth are very positive about 4-H and specific aspects of the program. The vast majority (90 percent or more) agree or strongly agree with the statements such as the following: "4-H teaches me to be responsible for my actions" and 4-H teaches me to help other people. Other program impact highlights include youth reporting: "All kinds of kids are welcome in 4-H," 97 percent; "I feel like I belong in 4-H," 89 percent; "4-H helps me accept differences in others," 90 percent; "I feel safe when I do 4-H activities," 93 percent; "In 4-H I feel that it is safe to try new things," 94 percent; "Boys and girls have equal chances to do everything in 4-H," 94 percent and "Both boys and girls can be leaders in 4-H" 94 percent.

c. **Source of Federal Funding** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

15. Key Theme: Parenting

(Reference OSU Plan of Work Extension Program 5L: Parenting and Family Life)

a. **Description of Activities –** Fifty-one (51) county Extension units submitted reports on efforts to: 1) provide court-mandated parenting classes for divorcing parents of minor children; 2) increase divorcing parents awareness of the ways their actions and behaviors influence the impact of the divorce on their children; 3) instruct divorcing parents on ways to reduce conflict in their post-divorce relationship and co-parent cooperatively; 4) provide knowledge and skills about basic child development, limit setting and appropriate methods of discipline to parents referred to Extension for parent education by agencies such as children's services, the juvenile courts, counseling centers, Department of Job and Family Services, early intervention programs, nursery school/child care facilities, or probation officers; 5) provide information and training to first time parents about basic infant care; 6) provide truancy diversion parent education; 7) provide basic parenting skills education to incarcerated parents; and 8) provide knowledge, skills and aspirations to fathers so that they participate more fully as actively engaged parents. Six issues of the Positive Parenting Newsletter were created and distributed to parents, grandparents, and other social service organizations throughout the state reaching 4,121 households. The on-line version of Positive Parenting received 11,156 visits. Three hundred eighty-six volunteers contributed 3,088 hours of their time, valued at $53,083.

b. **Impact -** Thirty-three thousand, seven hundred twelve (33,712) parents where reached with educational messages. Ten thousand, three hundred ninety-six (10,396) attended educational sessions. Of those, 77% (8,005) indicated they had learned new information and 57% (5,875) planned to adopt one or more recommended practices. When follow-up contact with program participants was made and the question asked, 3,246 individuals indicated they had actually adopted one or more of the recommended practices they had learned.

c. **Source of Federal Funding** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

16. Key Theme: Communication Skills

(Reference OSU Plan of Work Extension Program 5L: Parenting and Family Life)

a. **Description of Activities –** Ten (10) county Extension units submitted reports on efforts to increase knowledge, skills and attitudes that will positively impact family, couple, marital, and general interpersonal communication. The on-line website for the Marriage Matters newsletter received 7,743 visits. Thirty-six volunteers contributed 288 hours of their time, valued at $4,951.

b. **Impact -** One thousand three hundred thirty-eight 1,338) individuals where reached with educational messages and 993 attended educational sessions. Of those, 97% (963) indicated they had learned new information and 32% (322) planned to adopt one or more recommended practices. When follow-up contact with program participants was made and the question asked, 119 individuals indicated they had actually adopted one or more of the recommended practices they had learned.

c. **Source of Federal Funding** - Smith-Lever 3b&c

d. **Scope of Impact** - State Specific

Stakeholder Input Process

The College of Food, Agricultural, and Environmental Sciences of The Ohio State University was awarded a grant from the W. K. Kellogg Foundation to conduct a process that would create: 1) a new vision for food systems education, with implications for changes in land-grant universities and higher education across the country; 2) new structures for engaging citizens in vision building, decision making, and agenda setting; and 3) new models for educational responsiveness to constituent needs. The process entitled "Project Reinvent" brought together, through 18 focus group sessions, more than 230 individuals from the College, the University, and citizens of the State of Ohio to gather their views on what the College of Food, Agricultural, and Environmental Sciences must become to most effectively serve the needs of the people of Ohio and meet the challenge of the 21st century. External stakeholder groups participating in the focus sessions included farmers and producers, consumer and food advocacy/health care, food processors and retailers, agribusiness suppliers, commodity groups, environmental and natural resources groups, sustainable agriculture groups, legislators, primary and secondary educators, entrepreneurs/new technology, rural economic development groups, and media.

Some key highlights resulting from the focus groups input includes:

- The College adopted a new vision statement that would drive future decisions and an implementation grant was secured. Four teams were formed to address system change issues in:
  - Organizational structure
  - Reward system

Programmatic focus
Communication and marketing

- A team was formed to create a strategic plan for the Ohio Agricultural Research and Development Center, encompassing the Columbus and Wooster campuses and the 10 branch stations. In May 1998 the team presented the first phase of a strategic planning process, which identified a number of strategic issues and a series of experimental efforts to address those issues.
- Integrated systems approach identified and adopted as the foundation of the efforts within the College. The College recognizes that to sustain agricultural practices in the future the efforts must address issues of 1) production efficiency, 2) economic viability, 3) environmental compatibility, and 4) social acceptability in an integrated manner.
- A group of college and community leaders were brought together to serve as an ongoing advisory council to the Vice President and Dean of the College on issues that have widespread impact and implications for the College, its many units, and the full spectrum of audiences.
- An OARDC Internal Competitive Grants Program that matches funds from industry and other stakeholders with OARDC funds.

And the stakeholder input process continues. The Ohio Agricultural Research and Development Center and most academic departments have external advisory boards that meet at least quarterly to discuss current programs and provide input for future direction. Within the past 2 years in excess of 100 meetings have been held throughout Ohio with state legislators, community lay leaders, and representatives of Ohio State University Extension and OARDC to dialog on current educational and research programs and converse on future programs.

The Extension Community Development Program utilized a variety of methods to obtain stakeholder input. Many of these processes are intricate to the Community Development process itself. For example, appreciative inquiry, community asset assessment, and traditional needs assessments were used in twenty counties where full-time Community Development Educators are employed. Other community input programs were conducted in the Price Hill project in Hamilton County, the Comprehensive Community Planning Project in Highland County and Community Economic Development. Each of these boards conducts a year round program for community funds for the Community Economic Development Program Educators in other counties utilize Community Development Program Sub-committees that interact with the county Extension Advisory Committee.

The Ohio 4-H Youth Development program seeks stakeholder input in a variety of ways. Fundamental to the input are the local county 4-H advisory and subject matter committees located throughout the state. Furthermore, the many committees include the direct input from both adult and youth membership. Stakeholders are also involved on statewide committees to further ensure important input to the development and implementation of positive youth development programming in Ohio.

Stakeholder input through the Food and Nutrition Extension Advisory Committee indicates a desire of specific population groups to acquire the information and knowledge necessary to improve nutritional health. Teens active in sports want to understand how food can provide an "edge" in sports competitions. Teachers want resources for teaching the in-school pregnant teen

best nutrition choices for herself and for her baby. Older adults want to manage their blood pressure and their blood cholesterol levels. Older adults often express needs in one of two ways: those who are so busy that they want to prepare quick, nutritious meals or want to select healthy food choices at a restaurant and those who have no desire to prepare food because of declining health.

Program Review Process

Merit Review

(Note: The merit review process has not changed in FY 2006.)

OSU Extension develops long range program plans through a process involving Extension personnel from throughout the system, input of lay leaders in communities, incorporating data about Ohio's population, and through collaboration with other agencies, institutions and organizations.

Each of the four program areas conducts long range strategic planning to prioritize programming. Specialists from academic disciplines provide insight from research trends while county Extension personnel provide insight from local communities. Systematic prioritization processes, such as Delphi, are used. Program area personnel work together to identify key issues that cut across disciplines. Special task forces or teams then collaborate to identify priority program efforts to address these issues. Funding is then allocated to support program priorities. Programmatic resources such as personnel or materials reflect the program priorities. In addition, these priorities direct from what sources grant funds are sought.

Once strategic plans are in place, there is continual review of plans to include the ability to be responsive to unanticipated issues. The system provides flexibility for Educators to address these issues. In situations where grant monies are obtained, staff with specific, short-term employment contracts are hired to assist in meeting priority needs.

Educator specialization is a way for the system to provide subject matter expertise close to local communities. Educators determine a subject matter specialization that relates to needs in their geographical area of the state. They receive additional training to remain on the cutting edge of their field. They are encouraged to work with other educators in their region to address local needs in a timely manner. In addition, educators are linked to state specialists in the same discipline to enable the rapid dissemination of new information or the development of appropriate programming to address critical needs.

Scientific Peer Review

(Note: The scientific peer review process has not changed in FY 2006.)

Base funds (Hatch, McIntire Stennis, Animal Health) allocated to OARDC undergo an extensive review process within the OARDC system. The following describes the review process:

- Project proposals are initiated by research faculty and research scientists in consultation with colleagues and Department or Program chair.
- Chairs review all proposals. Chairs are responsible for selecting at least two peer reviewers for each proposal. The reviewers are expected to have expertise in the subject

matter area and can be from on campus or off-campus. The reviewers evaluate, recommend, and comment on each proposal.

- Reviews are returned to the proposing scientist who them responds to suggestions, makes changes, and resubmits the proposal to the Chair.
- Chairs indicate departmental approval by signing the AD-416.
- Following review and approval by Chairs, proposals are forwarded to the Experiment Station Director's Office where they are reviewed for accuracy in coding and format and concurrence with State Experiment Station and CSREES program directions. Revisions are requested if proposals are incomplete, are not sufficiently justified, or documented.
- Upon approval by the Director or his/her designee, projects are assigned a number and are electronically forwarded to CSREES for approval and inclusion into the Current Research Information System (CRIS). The Experiment Station Fiscal Office is notified of all approved projects wherein the Fiscal Office maintains records of expenditures to be used in the AD-419 and the Annual Report which are submitted to CSREES. The Experiment Station publishes the Annual Report to document and distribute scientific accomplishments and impacts.

Evaluation of the Success of Multi and Joint Activities

Agriculture and Natural Resource Extension Programs

Over the past several years, Ohio State Extension's Agriculture and Natural Resources (Ag/NR) program area has provided strong leadership to engage our 21 Commodity and Issue Teams to network with neighboring land grant universities. Within our annual report, we have profiled just a few of the very successful high profile programs, products and activities that are better leveraging our Federal, State, and County dollars to serve our very diverse industries and clientele.

Evaluations conducted by our multi-state committees and Teams have indicated that they feel that Multi-state conferences create improved learning opportunities and also better complement the discipline strengths of each institution. Many of our conferences and educational products have developed a strong tradition of support from clientele throughout the entire region. It is our vision to continue to provide a supportive environment to our Extension Field and State Faculties that will build upon these successful multi-state ventures.

Research Activities from a Research Perspective

Multi-disciplinary research teams have been formed to address critical issues. The Agroecosystems Management Team brings together stakeholders and those involved in research, teaching and outreach from different disciplines and institutions to discuss and develop whole systems approaches to the challenges affecting agriculture and rural communities. Its activities include public seminars on system research, sustainable agriculture and agroecosystems, sponsorship of stakeholder initiated workshops on sustainable management practices, and support of local learning communities. A practical management guide that relates basic principles of ecosystems based management to specifics of crop and livestock production has been produced. Educational materials have been developed for grade K-12.

The Ohio Compost and Manure Management Team was formed to build focus on issues and system technologies leading to safe, economic utilization of livestock manure with minimum odors and nutrient losses to water supplies. A video linked seminar series addressing manure management issues followed by discussion increased communication among stakeholders and provided an opportunity for networking with researchers and policy-makers. Organized tours of livestock and composting facilities that demonstrated effective waste management were conducted. A field day highlighting construction of a composting pad and treatment wetlands was attended by approximately 100 individuals. A website that highlights OCAMM goals, activities, seminar summaries, and link to sites with relevant information was developed.

Multi-state Extension Activities

1. Key Theme: Agricultural Communication

a. Description of Activity - The *Agricultural Outlook* is a multi-state effort (Purdue-Illinois-Ohio) to provide a comprehensive and timely hard copy and electronic commodity outlook guide for the Eastern Corn Belt farmers and Agri-business professionals. Lead editors from each state choose the various commodity experts in each participating state to provide both a short and long term outlook for commodities of major economic importance to this region. Each year, as many as twelve authors from the three participating states will produce this very timely and high demand publication.

b. Impact - Agriculture Economists and farm management specialists in Indiana, Illinois and Ohio prepared a 16-page annual Outlook publication which was inserted in the issue of the Prairie Farmer which is published/circulated in each state. The potential readership of farmer and allied industry personnel is over 240,000 subscribers.

c. Source of Federal Funds - Smith-Lever 3b&c

2. Key Theme: Agricultural Communications

a. Description of Activity – Michigan State/Purdue/DTN/Ag Answers Agreement (Electronic News Service) - This partnership is a joint effort to disseminate timely management/marketing information aimed at larger scale commercial farmers across the Eastern Corn Belt through the most widely subscribed farmer information network. Purdue, Ohio State and Michigan State Universities' specialists and research faculty on a daily rotation provide articles on contemporary crop, livestock production, and pest management.

b. Impact – Indiana, Ohio and Michigan cooperated in disseminating production oriented ag news, research results, contemporary advice from production extension specialists and AG/NR educators, and updated calendar event information to producers via electronic news systems. Potential readership is 210,000 farm families and agri-businesses across the eastern corn belt.

c. Source of Federal Funds - Smith-Lever 3b&c

3. Key Theme: Agricultural Profitability

a. Description of Activities - The Tri-State Dairy Nutrition and Management program effort provides an annual educational forum aimed at larger scale professional dairy producers and many professional industry consultants across the Eastern Corn Belt dairy region. Educational agendas range from the latest diet formulation software programs to recruiting and retaining new dairy farm employees and neighbor relations. Now in its 15th consecutive year, the symposium has garnered an international reputation among professional dairy nutritionists.

b. Impact - Dairy and Veterinary Extension Specialists from Indiana, Michigan and Ohio developed and conducted two educational dairy conferences focusing on contemporary nutrition and efficient management systems. Conferences focused educational agendas toward highly competitive dairy managers and professional allied industry (veterinarians, nutrition and reproductive specialists and herd consultants).

c. Source of Federal Funds - Smith-Lever 3b&c

4. Key Theme: Farm Science Review

a. Description of Activities - The Farm Science Review is recognized by the National Farm Show Council as one of the premier Farm and Home Shows in North America. Considered a flagship event sponsored by OSU's College of Food, Agriculture and Environmental Sciences and OSU Extension, the annual three day event averages 150, 000 people from throughout the eastern Corn Belt and Canada. OSU Extension has extended and invitation to Purdue University Extension to participate in the many educational venues focusing on Agriculture Production systems, Natural Resource Conservation and Management and Family Health and Consumer Information. Thirty two Purdue Extension Specialists, County Educators and Extension/Research Associates engaged with their OSU Counterparts to present the latest research information on topics in Universal Design, Pesticide Containment, Direct Marketing, Entrepreneurship and Woodland and Pond Management.

b. Impact - One of the newest educational events was an all day effort for Certified Crop Consultants (CCAs) held during the Review and allowed 45 CCAs from Ohio and Indiana to receive 22 Continuing Education Credits. The 45 CCAs represented over 1.8 million acres of Cropland in the eastern Corn Belt that they managed for many absentee land owners.

c. Source of Federal Funds - Smith-Lever 3b&c

5. Key Theme: Emerald Ash Borer Education

a. Description of Activities - *Emerald Ash Borer Preparedness:* Over the past year,

a Tri-State Team of Extension/Research Professionals from Ohio, Indiana and Michigan have conducted over 125 County, Regional and Multi-State Diagnostic and Eradication Programs for homeowners, woodland owners and commercial forestry professionals. The Multi-State, Multi-Disciplinary Team has members from OSU, Purdue and Michigan State Universities as well as respective state/federal agencies. Despite statewide quarantines and increased public awareness of timely "best management practices", this invasive pest continues to migrate toward new regions within all three states and a multi-state team focus will continue to be critical to addressing integrated pest management approaches. The Multi-State Team has 40 members representing Ohio, Michigan and Indiana.

b. **Impact** - The total economic impact of the Emerald Ash Borer on homeowners and private woodland owners over the tri-state region has been estimated to be $3Billion dollars since the pest was first discovered in 2002.

c. **Source of Federal Funds** - Smith-Lever 3b&c

Integrated Research and Extension Activities

1. Key Theme: Soybean Rust Education/Awareness

a. **Description of Activity** - OSU Extension's Agronomic Crops Team provided a coordinated research and extension initiative to prepare Ohio's Crop Producers and Crop Consultants for the threat of Soybean Rust, a potentially economically devastating fungal disease that has threatened Ohio's 1.4 Billion Dollar Annual Soybean Industry. Key OSU Extension County Educators identified 54 County Sentinel Plots within their respective counties which they routinely scouted themselves and with their respective host farmers and crop consultants. Led by OSU Extension Plant Pathologists and Extension Associates, this locally driven project fed weekly Soybean Rust articles embedded within the Team's Crop Observation and Recommendation Network (C.O.R.N.) Newsletter.

b. **Impact** - Due to timely scouting and diagnostic evaluations, no foliar fungicide applications were recommended or deemed necessary which saved Ohio's Soybean producers $18/acre. Overall savings on Ohio's 4.5 Million Soybean Acres was $77.5 million which could be directly added to Ohio farmers' profitability.

c. **Source of Federal Funds** - Smith-Lever 3b&c

2. Key Theme: Conservation Tillage and Technology Conference

a. **Description of Activity** - OSU Extension has provided coordination and leadership for the development of the Conservation Tillage and Technology Conference since 1980 making it the longest running conservation tillage conference in the United States. The current two day format typically has 60-70 speakers, including OSU Extension and Research Specialists and County Educators as well as other USDA Agency Professionals, Crop Consultants and Farmers. Participants can choose from

more than 30 hours of Certified Crop Advisor (CCA) credits on Soil and Water, Nutrient Management, Pest Management and Crop Management.

b. **Impact** - Attendance in 2006 reached 710, a new record. It is a regional conference drawing many participants from Indiana, Michigan and the rest of the Eastern Corn Belt. Approximately 322 participants received credits as Certified Crop Advisors and received 3,339 total CCA Credits. Farmer surveys demonstrated they valued the Tillage Conference Educational agenda at $12,500/Farm and that total direct impact for farmers attending was $2.5 Million. Approximately 125 Crop Consultants attended representing 5 Million Acres of Cropland and placed a value on their increased knowledge at $5/Acre. The total economic impact for managed or influenced by the Crop Consultants participating was $25 Million.

c. **Source of Federal Funds** - Smith-Lever 3b&c

3. **Key Theme: Community Development Research Projects**

a. **Description of Activity** - During 2006, OSU Extension Community Development partnered with faculty and staff at OARDC and others on a program called the *Why Trees Matter/Next S.T.E.P. Program*. *The Why Trees Matter/ Next S.T.E.P. Program* at the OSU Extension Center at Wooster is a multi-disciplinary program focusing on the benefits of community forests for citizens, the Green Industry, and the furtherance of scientific literacy. There are currently twenty OSU Extension educators and specialists from the Community Development and Agriculture and Natural Resources program areas along with representatives from the OSU School of Environment and Natural Resources and OARDC that are participating in this program. Representatives from the Ohio Department of Natural Resources, Division of Forestry are also members of the team.

The program is directly connected to the many emerging issues identified by OSU Extension as critical for Ohioans. It strengthens and enhances communities and neighborhoods by focusing on the important component of community tree resources, home values and community investment in tree canopies in the many cities and villages throughout Ohio. It enhances Ohio's educational capacity by significantly affecting the scientific literacy of thousands of Ohioans directly through educational programming and many more through educational materials that are being developed. (plant, pest and disease profiles, website development, community tree census tools). It contributes to growing the green industry through the strong relationship between the *Master Gardener Program*, the *OSU Extension Nursery Landscape and Turf Team and the OSU Extension Woodland Stewards Team* members and their relationships with the *Ohio Nursery and Landscape Association* and the *Ohio Chapter of the International Society for Arboriculture* relative to tree selection and tree care practices. Finally, this initiative connects with maintaining and enhancing Ohio's water quality and air quality relative to the considerable environmental impacts of enhanced urban and suburban forests in Ohio.

b. Impact –

- The first "Why Trees Matter" Conference was held where 87 appointed and elected officials from various cities, townships and villages from throughout Ohio learned about the economic impacts of community street trees.
- Assessment programs are currently being conducted in three communities in Ohio to determine the impact of the loss of tree canopy resulting form disease, or construction in the public right of way.
- Ninety-three community volunteers are participating in a Master Gardener Street Tree Stewardship program that will train participants to inventory community street trees.
- Fifteen acres of the Seacrest Arboretum at the OARDC campus in Wooster has been dedicated for Street Tree Research with alternative funding sources for said research being pursued.
- A Web Site has been developed and will be launched in 2007 as an outreach and educational tool for Citizens of Ohio and others for assistance with Street Tree Issues.
- $20,000 of research and grant dollars have been obtained up to this date for this fledging program.

c. Source of Federal Funds - Smith-Lever 3b&c

4. Key Theme: Food Security

(Reference OSU Plan of Work Extension Program 3Ae: Human Nutrition/Health)

a. Description of Activity - The rationale for *"Choice food pantry: Community feedback, improvement and dissemination"* was: Although in the United States there is plenty of food, some families – especially minority groups – don't always have access to good quality food, and some of them even go hungry. Food insecurity, defined as being uncertain if there are adequate resources to provide food for all family members, is a reality for millions in the US. In Ohio, on average 10.9% of all households experienced some food insecurity on a yearly basis from 2001-2003. Although the relationship is poorly understood, research has shown that low-income populations have a higher risk for being overweight. This might be due to lower food expenditures that leads to poor diet quality with high fat, high calorie diets, and low fruit and vegetable consumption.

Food pantries have the potential to address both food insecurity and poor diet quality by distributing healthy food at no cost to low-income families. However, some individuals will not access food pantries because they may feel ashamed. Others may access them, but will not use all the food they are receiving because it doesn't meet their food preferences, and therefore some food may be wasted.

Partnering Agencies in Butler County, Ohio, are using the "choice" food pantry model to address food insecurity and poor diet quality. These choice food pantries allow clients to choose food items using a point system allocated according to the client's family size and guided by the USDA Food Guide

Pyramid. This way, the clients choose food based on need and preference. The *choice food pantry* might be more dignifying, with less waste, and provide an opportunity for nutrition and money management education.

The objectives of the project are: To explore the process of converting a traditional food pantry to a *choice food pantry* from a consumer and provider point of view; to identify food consumption and health issues related to the use of choice food pantries; and to identify barriers that might be relevant to choice food pantries, including their perceptions on the impact of changing the food pantry from a non-choice food pantry to a *choice food pantry*.

Perceptions and attitudes on challenges, advantages and limitations of the transition from a traditional food pantry setting to a choice food pantry system were examined through focus groups on administrators, staff, volunteers and customers of food pantries in Ohio. Perceptions of customers were examined separately with English and non-English speaking population groups. Transcripts were analyzed separately by researchers to identify and compare emerging themes. Emerging themes were confronted against each other, and themes were compared among the four focus groups to identify convergences and divergences. Choice food pantries are perceived as a more dignifying way of proving food to poor families. This system generates less waste, and allows a better and more dynamic interaction among the different actors. The "*Rainbow Colors*" system used to help customers to choose their foods relates to the new dietary guidelines and in *MyPyramid*. Therefore, choice food pantries offered a great opportunity to provide customers with nutrition education classes. Nevertheless, providing of a more varied food supply represents a big challenge for the pantries. Scholar products of this study are being generated as oral and poster presentations for local and national meetings, as well as one manuscript for a national scientific journal in nutrition. Research questions to be responded related to the differential impact of choice food pantries when compared to traditional food pantry settings.

b. **Impact -** For the first time perceptions and attitudes on challenges, advantages and limitations of the transition from a traditional food pantry setting to a choice food pantry system were examined on a diverse audience constituted by administrators, staff, volunteers and customers of food pantries in Ohio. In addition, given the large proportion of individuals of Latino origin who are using food pantries in southern Ohio, the perceptions of customers were examined separately with English and non-English speaking population groups.

One of the major accomplishments of this program was the generation of a support network of local agencies and institutions related to food pantries, which easily allowed the conduction of four focus groups in food pantry settings. In each of the focus groups, which were conducted on January 18th and January 30th in Butler County, we had between 6 to 10 participants. Both groups of customers English and Spanish speaking customers included 10 individuals.

Another accomplishment of this program relates to the great interest it generated among institutions involved in the food pantry system. Researchers in this project were invited by Ohio Association of Second Harvest Food-banks to give their advice in the development of a training manual and a video on how to transition from a traditional food pantry to a choice food pantry – **Making the Switch. A Guide for Converting to a Client Choice Food Pantry**.

Given that the "*Rainbow Colors*" system used to help customers to choose their foods relates to the food groups and colors used in the new dietary guidelines and in *MyPyramid*, choice food pantries offered a great opportunity to provide customers and volunteers with nutrition education classes. Although the purpose of this program was not to provide these classes, FNP staff in Butler County has already started to provide customers with food preparation shows focusing on how to use some of the foods available at the pantry. Great interest has been expressed by choice food pantry administrators in supporting these activities and others related to nutrition education.

Finally, from a research point of view, this project offers information on how the main actors in the food pantry environment perceive the transition, and how they feel the process will affect the functioning of these agencies. The results of this program will be integrated into the future transitioning food pantries helping to avoid or work out some of the problems confronted by those who experienced the transition already.

Once the focus groups were completed, the resulting notes and audiotapes were stored in the Department of Human Nutrition at OSU, were the transcription of its content took place. Transcripts were analyzed separately by researchers to identify and compare emerging themes. Emerging themes from each analyst on each of the focus groups were confronted against each other. Subsequently, the themes were compared among the four focus groups to identify convergences and divergences. As reflected by the following summary of the focus groups, there are similarities between how advantages and challenges are perceived by the different actors. Nevertheless, having documented "the voice" of each of the groups involved will allow others to learn about possible issues in advance, and therefore be able to work to confront them earlier.

The administrators expressed several benefits for the choice pantry system that complemented those mentioned by the participants. As many are directly affiliated or sponsored by faith-based organizations, the administrators felt they could better fulfill their outreach, ministry mission in the new organization. The previous mechanism of quickly distributing previously bundled bags offered little time for face to face interaction and community support. Having the time for the volunteers to walk through the "store" to choose their items fostered time for more inquiry about life situations. With this additional time availability comes with the challenges of obtaining adequate help to cover shifts. The administrators felt it was sometimes easy to secure a group of volunteers for a bulk of hours packing bags, but now it is a challenge for individuals to offer enough time to cover the longer hours of operation to serve the participants.

The participants in the choice food pantry expressed several advantages and disadvantages to the pantry design. Under the traditional pantry procedures, they received prepackaged bags of food, which may or may not contain foods members of the families would eat. Thus a great deal of food would go to waste or need to be "traded" to obtain acceptable foods in the household. The choice food pantry allowed these participants to select foods within each food group that was more tailored to their personal preferences. The empowerment gained by the ability to choose one's own foods added some dignity and sense of ownership to the operation. Several of the participants, who are aware of the additional work

and space necessary to carry out a choice pantry, have begun to volunteer at the facility. Another challenge that arose during the discussion was the lack of knowledge to prepare certain foods that have been available. Cooking demonstrations have been useful in educating participants how to make healthy meals out of the foods available, especially uncommon foods like figs.

Issues of food quality and nutrition were not of major concern to the participants. They felt the food they received was healthy and safe, though the types of food available were sporadic and based on donation. This was a similar concern among the administrators. Often, many foods were received in bulk and were distributed until gone or spoiled. Furthermore, when food donations are low, they must purchase additional foods to cover the food groups encouraged by the food selection cards. Of primary concern was the reliance on food drives that often are heavily laden toward the holidays and sparse in other times.

Finally, volunteers recognized that the new system results in less wasted food, and that it provides them with the opportunity of a more dynamic interaction with the customers. On the other hand, the new system requires more time, and to be more prepared to fulfill the task of advising and orienting the customers to make the choices they have.

c. Source of Federal Funds - Smith-Lever 3b&c

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Actual Expenditures of Federal Funding for Multistate Extension and Integrated Activities
(Attach Brief Summaries)
Fiscal Year: 2006

Select One: ☐ **Interim** **X Final**
Institution: The Ohio State University
State: Ohio

	Integrated Activities (Hatch)	Multistate Extension Activities (Smith-Lever)	Integrated Activities (Smith-Lever)
Established Target %	11.4% **%**	5% **%**	7% **%**
This FY Allocation (from 1088)	$5,508,619	$9,697,752	$9,697,752
This FY Target Amount	$627,983	$484,888	$678,843
Title of Planned Program Activity			
An Agricultural Production System That is Highly Competitive in the Global Economy	$682,777	$93,346	$282,022
A Safe and Secure Food and Fiber System	20,062	45,057	21,330
Healthy, Well Nourished Population	30,755	155,487	30,201
Greater Harmony Between Agriculture and the Environment	341,162	138,527	232,540
Enhanced Economic Opportunity and Quality of Life for Americans	128,390	78,566	198,793
Total	$1,203,146	$510,983	$710,886
Carryover	0	0	0

Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays represented here accurately reflect allowable expenditures of Federal funds only in satisfying AREERA requirements.

Director, OSU Extension

Director, OARDC

March 30, 2007
Date

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Multi-state Extension Activities and Integrated Activities
(Brief Summaries)

Goal 1: An Agricultural System that is Highly Competitive in the Global Economy

Ohio's Commercial agriculture and horticulture industries depend upon Ohio State University Extension to provide timely and innovative, science-based, objective information that can be implemented within their management systems to remain competitive in our global economy. An innovative approach to problem solving, research and extension outreach is the use of empowered teams. A high priority for The Ohio State University Extension is the development and coordination of commodity/issue focused teams consisting of State/District Extension specialists, County Agriculture and Natural Resource agents and research faculty from multiple disciplines to deliver high impact, research-based information and educational programming that is timely and easily accessed by Ohio's diverse commercial agriculture and horticulture industries.

Ohio State University Extension and the Ohio Agricultural Research and Development Center have currently engaged 21 interdisciplinary self-directed teams ranging from our Swine Educators' Team to our Watershed Management Network. These faculty-led teams interact closely with respective state/national commodity organizations, state/federal agencies and environmental organizations to assist in developing our Extension led statewide programming and current communications structure.

Team electronic communications are the keys to access strategic information for global competitiveness. Many of our teams continue to develop weekly/monthly electronic newsletters and research updates that will be evaluated for their economic impact. Our team members develop newsletters following weekly tele-conferences such as: *Amazin' Graze, Buckeye Yard and Garden Line (BYGL), Crop Observation and Recommendation Network (CORN), Grain Marketing Research and Innovative Strategies (GRAINS), Pesticide Update (Pep-Talk), Pork Pointers, Veg-Net and Vineyard Vantage*, etc. Many newsletters are listed on our OSU Extension *Ohioline* web site, as well as many of our team's individual web sites for easier access by our stakeholders.

Goal 2: A Safe and Secure Food and Fiber System

Safe food handling is a targeted issue and includes: Promoting food safety across the food chain; consumer education for safe food handling; certificate training for food handlers; and food safety education for growers, producers, distributors, retailers, and food service workers. At the same time that food safety is an issue, consumers demand and will pay for greater convenience. The challenge is to produce food which is nutritious and tasty but which can be processed and distributed without contamination, either accidentally or deliberately, and is handled safely as it is prepared by and for consumers.

Consumers' lifestyles, hence their eating habits, are constantly changing. These changes bring about increased demand for high quality, value added, and convenient foods. This requires that production of food ingredients, which are as nutritious as non-processed counterparts and are not subject to contamination with harmful microorganisms during production and shipment.

Although research that leads to a safer food supply is actively in place, scientists acknowledge that the safest foods are still a hazard if mishandled during food preparation just before consumption either in a food establishment or at home. Consumer and food worker behavior is an important issue to address to complete the assurance of the safe food cycle. Education efforts, either in higher education or through outreach, have focused on this critical need so that the "human factor" can be reduced or eliminated as a cause of food-borne illness.

Goal 3: A Healthy, Well-nourished Population

Dietary Guidance can be defined as the use of principles found in the Dietary Guidelines for Americans to develop non-formal nutrition education series for youth and adults. Additionally, there are programs targeted to the elderly, and to individuals at risk for or having diabetes, focusing on their nutritional needs. These community-based nutrition education programs are offered at the local level by OSU Extension. The Dietary Guidelines for Americans provide a basis for healthy lifestyle choices. The Food Guide Pyramid is a pictorial and practical guide for educating consumers to use the Dietary Guidelines. OSU Extension professionals inform consumers of health risk factors (e.g., obesity, hypertension, etc.) and nutrition practices and encourage appropriate nutrition and lifestyle changes and promote reading labels on processed foods.

U.S. citizens, like other highly developed countries in the world, have an abundant, inexpensive food supply available to them. Food provides both pleasure and the nutrients necessary for health and survival. The goal is for all to be food secure, that is, access by all people at all times to enough food for an active, healthy life and at a minimum, includes: (1) the ready availability of nutritionally adequate and safe foods, and (2) the assured ability to acquire personally acceptable foods in a socially acceptable way. It is important to recognize that nutrient needs vary over the life cycle and research must be conducted to determine how age and gender influence nutrient needs. It is also important to recognize that the human body uses nutrients in chemical reactions within the body. Nutrition science plays an important role in reducing obesity, diabetes, cancer and heart diseases. The Ohio State University is one of a few institutions with a college of agriculture, a department of human nutrition science, and a medical college. Scientists from the many disciplines are researching together such agricultural products as tomatoes, soybeans, and raspberries to discover the chemical content and chemical reactions in hope of discovering chemicals that are effective as antioxidants and as anti-carcinogens. They are also researching behaviors that lead to healthy food choices.

A healthy, well-nourished population is dependent on the ability of people to obtain foods that will improve the over-all quality of their diets, and the quality of the food they eat. A healthy population also engages in other positive health practices, including physical activity, individual health monitoring, and safety practices that will reduce the risk of accidents and disease. OSU Extension professionals have been actively educating the people of Ohio regarding the importance of good health and nutrition practices. The professionals met with individuals

and groups, in formal and non-formal teaching sessions, in workshops, committee meetings, health fairs, and walk-by exhibits. The result has been a change in 1) the way some individuals purchase, prepare and store food; 2) the level of interest in monitoring and improving health through screenings and exams; and 3) the ability of individuals to improve their personal practices to decrease health risk.

Goal 4: Greater Harmony between Agriculture and the Environment

Ohio is different than most sister states in that it has a relatively high population density and yet agriculture [defined broadly to include plant and animal production, food and food processing and landscape/turf] leads all other industries in dollar value, amounting to about $75 billion annually. This commingling of agriculture and food processing with large urban and suburban population centers provides opportunities but also challenges. Most often the challenges are the disposal of wastes and by-products without offending the aesthetic sensibilities and quality of life of neighbors. Efforts to solve these problems have long occupied the time of OARDC scientists and OSU Extension programming and continue to do so with the development of new methods and technologies.

An area which causes some friction between urban populations and agriculture are the perceived dangers of chemicals used for pest control. Ironically, much of the use of pesticides is by home owners and companies treating lawns and golf courses within urban - suburban centers. One method to reduce pesticide use is called integrated pest management (IPM) in which management and natural enemies of pests are used to decrease the need for insecticides. The use of a species of round worms (nematodes) to control white grubs in turf grass is highlighted here as one example of IPM.

In addition to the usual methodology to minimize environmental damage, scientists at The Ohio State University have created a team, called ecosystems management, which seeks to use ecologically sound principles to not only increase profitability but also be environmental friendly. This systems management approach has been extended to the classroom in the education of undergraduate as well as graduate students.

As livestock production continues to expand in Ohio and with the odors, dust, insect pests, and water pollution associated with the increased numbers, there is a need to provide educational programs to producers on composting livestock mortality and composting animal waste. Due to the diverse distribution of the state's population, livestock producers, commodity groups and OSU Extension are taking a pro-active approach to improve neighbor relations by providing programs that ameliorate issues associated with agricultural waste.

Goal 5: Enhanced Economic Opportunity and Quality of Life

During the decade of the 90's, most Ohioans prospered but many others were left behind. As economic difficulties continue in the 21st Century, lack of economic opportunities worsens, particularly in Southeastern Ohio which has been in decline since the coal industry moved out. Agriculture, mostly in the form of beef cow and calf operations and forage crops provide some opportunity but others are needed. One of the possibilities

that have been explored is aquaculture, represented here by the newest entry in the field, fresh water shrimp. Production of these crustaceans for a niche market can provide some income to residents of this economically depressed area.

OSU Extension personnel provide the lead in about a nine counties for their community economic development programs. Extension works on a total community development paradigm. In the economic development strategies, the Business Retention and Expansion Program continues to be enhanced by the Department of Agricultural, Environmental and Development Economics. This flexible consulting program assists the local community in selecting their own survey tool and reporting mechanism. The community is provided the items and assistance they request. Retention and Expansion Programs are conducted for nearly all sectors of the economy including industrial, agricultural, retail and service. Additional assistance is provided in educational programs on enterprise zones, joint economic development districts, and tax abatement. Assistance is also provided in attraction and community capture of local discretionary income.

Programs are also available for local leaders and government officials on wastewater treatment alternatives and water supply systems. Extension educators in several counties work closely with local groups in the creation and operation of revolving loan funds and the establishment of industrial parks. Some of the Community Development Agents conduct downtown revitalization programs and state route corridor development projects.

Community Leadership Development is a wide-ranging area that includes operation or assistance of year-long leadership training programs. More ad hoc programs include training for members of non-profit boards of directors. Leaders are instructed in such programs as: appreciative inquiry, finding and mobilizing community assets, and Vision to Action. The Public Issues Team provides instruction on Framing of Issues and dispute resolution.

The Ohio 4-H Youth Development program provides positive environments for culturally diverse youth and adults to reach their fullest potential as capable, competent, caring and contributing citizens thus enhancing their quality of life. As a result of the Ohio 4-H positive youth development experience: youth develop marketable skills for lifelong success; youth participate in and learn through citizenship opportunities to transform local communities; youth appreciate and build upon diversity to foster a harmonious global society; youth have a sustained relationship with a caring adult to enable them to be productive citizens; and volunteers build their skills and abilities in working with youth.