V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Global Food Security and Hunger - Crop Enterprises

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	20%		5%	
133	Pollution Prevention and Mitigation	3%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		20%	
204	Plant Product Quality and Utility (Preharvest)	11%		10%	
205	Plant Management Systems	35%		20%	
211	Insects, Mites, and Other Arthropods Affecting Plants	5%		10%	
212	Pathogens and Nematodes Affecting Plants	4%		10%	
213	Weeds Affecting Plants	5%		5%	
215	Biological Control of Pests Affecting Plants	2%		5%	
216	Integrated Pest Management Systems	10%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	18.0	0.0	6.0	0.0
Actual Paid Professional	22.0	0.0	15.0	0.0
Actual Volunteer	3.6	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
590000	0	576055	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
590000	0	576055	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
2115855	0	3186466	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Wheat cultivar performance testing and demonstration throughout Oklahoma

Wheat breeding, variety development, and introgression of new traits into elite germplasm

Publication of web sites, web-based updates, video presentations, and printed extension materials that disseminate research findings and address current and emerging issues in Oklahoma agriculture

Provide effective, non-classroom educational opportunities for industry professionals, Extension educators, farmers, and ranchers.

Conduct on-farm research and demonstration of nitrogen rich strips and use of hand-held sensors

Explore opportunities for market-based solutions to global climate change and evaluate potential for Oklahoma stakeholders to participate in these opportunities

2. Brief description of the target audience

Wheat growers, dual-purpose wheat producers, millers, bakers, wheat importers, seed growers and dealers, wheat breeders, crop producers, canola, peanut, sunflower and other crop producers and nutraceutical producers.

3. How was eXtension used?

Dr. Randy Boman is active in the Cotton CoP. He participated in conference calls and a meeting in Kansas City to establish the eXtension cotton Web site. We provided numerous numbered publications to upload to the Website. It was launched at the Beltwide Cotton Conference in Nashville in January, 2008. In 2012, this was still actively supported by our Beltwide Extension Cotton Specialist Working Group, a true multi-state research and extension effort. He continues to serve as the subject matter editor for the Ginning and Classing section for the Cotton Community of Practice. All subject matter sections were updated in the fall of 2012 by the various editors. Dr. Guy Collins of the University of Georgia is handling coordination of content updating. We have a direct link on both websites we manage. URL: www.extension.org.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	99222	5726735	2300	30000

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2012

Actual: 2

Patents listed

PVP on wheaat cultivar 'Gallagher' and a PVP on wheat cultivar 'Iba'

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	18	16	34

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Field Demonstrations

Year	Actual
2012	215

Output #2

Output Measure

- Varieties of wheat released

Year	Actual
2012	2

Output #3

Output Measure

- Crop production manuals and production newsletters

Year	Actual
2012	71

Output #4

Output Measure

- Cotton Web Page

Year	Actual
2012	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percentage of dual-purpose wheat acreage where first hollow stem criterion used for decision making
2	Number of wheat varieties released to address agronomic and end-use quality needs of hard red winter wheat industry
3	Locally-controlled evaluations and agronomic data for oilseed crops
4	Percentage of wheat acres sown to varieties with improved pest resistance, yield potential, and end-use quality.
5	Increase in knowledge and adoption rate of reduced tillage practices and crop rotation - acres effected
6	Number of crop acres where fertilization decisions include sensor-based fertilization information
7	Locally-controlled evaluations and agronomic data for small grains crops
8	Expansion of pedigreed seed production and capacity to increase wheat grain yield and end-use quality
9	Drought Probability Assessment in Oklahoma
10	Best management practices for pasture recovery following drought.
11	Agricultural Testing Reduces Production Costs and Minimize the Impact of Agriculture on the Environment
12	Improved Chicken Litter Handling and Transport
13	Increasing phosphorus use efficiency of wheat
14	Feasibility analysis of a market based incentive program for decreasing N2O emissions in Oklahoma through improved nutrient management.
15	Swine Effluent Project

Outcome #1

1. Outcome Measures

Percentage of dual-purpose wheat acreage where first hollow stem criterion used for decision making

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	75

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Wheat fields utilized for livestock grazing during the fall/winter and then harvested for grain by early summer are termed "dual-purpose" wheat fields. Proper timing of livestock grazing termination at the ¼ inch First Hollow Stem (FHS) stage of growth is critical in avoiding large grain yield losses caused by overgrazing wheat pastures. Because grazing termination dates can vary greatly on a field-by-field basis due to planting date and the particular variety planted, FHS is the single best way for stocker cattle producers to determine exact times for grazing termination. Oklahoma has about 5.7 million acres of wheat planted annually, of which, about 2.5 million acres are utilized by farmers as ?dual-purpose? wheat acres.

What has been done
Research indicates overgrazing wheat pasture by just one week can result in a decreased grain yield of up to 25% at harvest and mistiming grazing termination by two weeks will reduce the bushels of wheat at harvest by up to 60%! Given average yield, this equates into a 19 bu/ac loss. At current prices, this amounts to a $150 + per acre potential loss of income for "dual-purpose" wheat producers or a $380,000,000 potential annual loss for the state of Oklahoma. To help prevent these losses, we monitor first hollow stem, conduct in-service trainings, and hold grower workshops on methodology and benefits of scouting for first hollow stem.

Results
It is estimated that at least 75% of dual-purpose wheat producers in Oklahoma use first hollow stem as a criterion for removal of cattle from wheat pasture. First hollow stem was monitored at two locations (Stillwater and El Reno, OK) and data were distributed to extension educators and stakeholders via electronic newsletter. It is estimated that at least 75% of dual-purpose wheat producers follow these numbers and use them as a "rule of thumb" estimator for removal of cattle from wheat pasture. That change from traditional methods helped producers reduce lost

production by about $285 million in 2012.

Several producers have commented on the usefulness of this information. A prominent rancher in southern Oklahoma, for example, commented "I appreciate you guys distributing the first hollow stem data from the El Reno site. It matches what I have been finding in my field and lets me know that I am making the right decision".

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #2

1. Outcome Measures

Number of wheat varieties released to address agronomic and end-use quality needs of hard red winter wheat industry

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Wheat and the associated grazing component are worth in excess of $1.5 billion annually to the Oklahoma economy. In the winter-wheat market, farmer profitability is yield-driven while end-user value is quality driven. While yield potential and end-use quality are not mutually exclusive traits, developing and marketing cultivars that satisfy both requirements is extremely difficult. The fact that there are relatively few scientists and even fewer private companies working in the area of wheat improvement exacerbates the problem.

What has been done
The Oklahoma State University Wheat Improvement Team was developed as a cross-cutting collection of scientists who work collaboratively to develop, test, and distribute improved wheat cultivars for the Southern Great Plains. As part of this effort over 900 individual crosses are made on a yearly basis. In addition approximately 45 cultivars are evaluated in replicated small grain

performance trials at 24 sites throughout Oklahoma. Farmers are involved in both of the processes through advisory organizations and direct participation in research trials.

Results
The Oklahoma Agricultural Experiment station released the hard red winter wheat cultivars "Gallagher" and "Iba" in 2012. These cultivars represent the efforts of the Oklahoma State University Wheat Improvement Team to improve upon "Duster", the most popular wheat variety in the state. Gallagher offers increased yield potential, foliar disease resistance, and kernel size without sacrificing Hessian fly resistance, acid soil tolerance, or fall forage production for dual-purpose systems. Iba offers increased yield potential, foliar disease resistance, and kernel size with an extremely broad area of adaptation. It is anticipated that these two varieties will capture the 1.2 million (22.2%) of Oklahoma wheat acres currently occupied by Duster in the next five to seven years, reducing the need for fungicides while increasing farmer profitability. Licenses from released varieties have generated approximately $1.15 million in intellectual property income for Oklahoma State University thus far.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #3

1. Outcome Measures

Locally-controlled evaluations and agronomic data for oilseed crops

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

For many years the vast majority of Oklahoma cropland acres have been seeded to continuous winter wheat. For example, in Canadian County from 1998 to 2007, 87 percent of total crop acres were seeded to wheat. Continuous cropping of annuals contributed to the buildup of yield-constraining weeds, diseases, and insects. Economic returns have been hampered by yield losses and by reductions in grain quality.

For years, crop rotations had been recommended to mitigate these problems. However, crop rotations were not common in Oklahoma. Alternative winter small grain crops such as oats, barley, and rye were not economically competitive. In many cases, attempts to include summer crops such as corn, soybeans, and grain sorghum were not successful because they do not fit well in a rotation with winter wheat and do not perform well in dryland conditions in Oklahoma. On average, 16 percent of planted soybean acres and 17 percent of corn acres planted for grain in the state are not harvested. In some years corn is plagued with mycotoxins. In 2011, 40 percent of the acres planted to soybeans in the state were abandoned. Similarly, in 2011, 36 percent of the acres planted to corn were not harvested for either silage or grain.

What has been done

Prior to 2004, winter canola was not produced in the state, there was no local market for canola, and Oklahoma producers did not have an economically viable alternative winter crop to rotate with winter wheat. OSU under the leadership of Dr. Peeper assembled a multidisciplinary DASNR team and initiated a comprehensive research program.

Results

The team developed best management practices for canola and determined that (a) wheat yields following canola were significantly greater than wheat yields experienced in continuous wheat and (b) expected net returns are greater for canola-wheat rotations than for continuous wheat. Producers respond to economic incentives.

Prior to 2004, winter canola was not produced in the state. In 2009, for the first time, the Oklahoma Agricultural Statistics Service reported canola planted acres.

Crop year	Canola Acres as reported by OASS
2003-04	0
?	?
2008-09	42,000
2009-10	60,000
2010-11	100,000
2011-12	150,000

This growth in canola acres is one result of the OSU Crop Management Team.

- Wheat producers have an economically viable alternative for managing weeds and diseases.
- Several buyers are active in the State
- Canola is processed in the state.
- Private companies are investing in variety development.

If private companies continue to assist with investments in variety development and crop management research, winter canola could be become an important economic development engine for the state of Oklahoma. In addition, the overall quality and value of hard red winter wheat delivered to Oklahoma elevators could be improved substantially.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #4

1. Outcome Measures

Percentage of wheat acres sown to varieties with improved pest resistance, yield potential, and end-use quality.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	47

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2006 over half (54%) of all wheat acres were sown to the cultivar "Jagger" or the Jagger-by-Abilene cross Jagalene. In addition, many newer wheat cultivars have offered increased yield as compared to Jagger and Jagalene, but have relied on Jagger resistance genes to fight the problematic foliar diseases leaf and stripe rust. Shifts in disease races over the past four years have made these genes largely ineffective, presenting an unnecessary production risk for farmers and grain merchandisers.

What has been done
Since 2006, the Oklahoma State University Wheat Improvement Team has developed and released ten wheat cultivars with disease resistance and agronomic performance superior to that of Jagger and Jagalene in targeted environments. In addition, our newest releases and advanced experimental lines contain insect and disease resistance genes different from those in Jagger. A comprehensive educational campaign has made farmers and ranchers aware of improved cultivars released by land-grant institutions and private breeding companies in the region.

Results
In 2012 acreage of Jagger and Jagalene had fallen to 8% and 2%, respectively. Acreage of the

disease and Hessian fly resistant cultivar 'Duster' increased from 0.3% of acreage in 2007 to 22.2% in 2012 and improved cultivars now occupy 47% of Oklahoma wheat acres. Unfortunately, the disease resistance of Jagger-derived lines such as 'OK Bullet' and 'Fuller' are no longer highly effective at preventing foliar disease and future efforts will focus on displacing these varieties with superior genetics of newer lines such as 'Gallagher' and 'Iba'. Gallagher, for example, fits a similar production profile as Duster but offers increased yield potential, foliar disease resistance, and kernel size without sacrificing Hessian fly resistance, acid soil tolerance, or fall forage production for dual-purpose systems. In 2012 Gallagher offered a 5.9 bu/ac average yield advantage over Duster, indicating a potential increase in Oklahoma farm revenue of $53 million annually if we meet our target of replacing 1.2 million acres of Duster with Gallagher in the next five to seven years.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #5

1. Outcome Measures

Increase in knowledge and adoption rate of reduced tillage practices and crop rotation - acres effected

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number of crop acres where fertilization decisions include sensor-based fertilization information

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	500000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Current global nitrogen use efficiency for cereals production is estimated to be 33%. Environmental concerns and increasing fertilizer prices have necessitated improved precision in determining crop nitrogen requirements.

What has been done
Oklahoma State University has developed hand-held sensors and corresponding web-based decision aids that can be used to generate in-season nitrogen recommendations based on yield potential. This method is much more accurate than yield-goal-based systems in predicting high or low-yielding years where nitrogen fertilizer application rates should be adjusted accordingly. Sensor based nitrogen management presentations and demonstrations were given at 40 grower meetings with approximately 2,600 individuals in attendance in 2012. Two websites devoted nutrient management (nue.okstate.edu and npk.okstate.edu) were viewed approximately 19,500 times in 2012.

Results
In the fall of 2012 it is estimated that the N-Rich Strip and SBNRC was established on nearly 500,000 acres of Winter Wheat and Winter Canola. Recent research concluded that this technologies increases profit in winter crops by $10/ac resulting in a state wide impact of approximately $5 million. Additional to the success of the N-Rich strips is the commercialization of the smaller Hand Held GreenSeeker sensor. This sensor is sold at 10% of the cost ($495) of the larger unit historically used. The new Hand Held has been selling well in Oklahoma and across the United States. The Hand Held has also meet great support internationally. The adoption of this low cost sensor will greatly impact the state of Oklahoma as the implementation of the N-Rich Strip and Sensor Based Nitrogen Calculator which will ultimately the increase economic and environmental sustainability of winter wheat production in Oklahoma.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems

Outcome #7

1. Outcome Measures

Locally-controlled evaluations and agronomic data for small grains crops

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	65

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Choosing the right cultivar is essential to ensuring economic profitability of any production system. Wheat yield data collected in 2010, for example, show that cultivar choice can easily increase gross income by more than $120 per acre and dramatically reduce pesticide use.

What has been done
The Oklahoma State University small grains variety testing program tests 25 to 45 released wheat cultivars and advanced experimental lines in replicated test plots at 25 to 30 sites throughout Oklahoma on an annual basis. The wheat multi-use team sows 40 to 45 additional non-replicated wheat variety demonstration tests at sites throughout Oklahoma. All but five of these sites are located on-farm and are conducted with the assistance of farmer-cooperators.

Results
Field day attendees typically represent over 1.7 million acres of wheat and report an average perceived value of the information received at field day events to be $21.46 per acre for a total impact of over $37 million annually.

Wheat phenological data, forage yield, grain yield, test weight, and protein content data were collected and posted near real time on the Oklahoma small grains variety testing site at www.wheat.okstate.edu. This site received over 32,000 page views in 2012 and was reinforced with the @OSU_smallgrains Twitter feed. Hard copies of results were distributed to over 8,000 stakeholders in the state of Oklahoma via direct mailing and to over 600 producers via electronic copy.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #8

1. Outcome Measures

Expansion of pedigreed seed production and capacity to increase wheat grain yield and end-use quality

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Quality seed is the foundation for profitable and sustainable crop production. Unfortunately, most wheat acres in Oklahoma are seeded using farmer-saved seed with low purity and/or quality. In addition, farmer-saved seed is frequently contaminated with Italian ryegrass or other weed seed that ultimately reduce the marketability and end-use quality of Oklahoma wheat. Increasing the use of pedigreed seed would alleviate many of these issues and increase farmer access to improved genetics. Demand for certified seed has increased among farmers, but greater production capacity at all levels of the certification process (foundation, registered, and certified) is needed to ensure adequate supply.

What has been done
The Oklahoma Crop Improvement Association (OCIA), Oklahoma Foundation Seed Stocks (OFSS), private seed retailers, and Oklahoma Cooperative Extension have increased awareness regarding the importance of seed quality. Certified seed availability was increased using a three-pronged approach. First, a conscious effort was made to recruit new certified seed producers and to increase capacity of current certified seed producers. Second, release of new wheat varieties by the Oklahoma Agricultural Experiment Station was delayed by one year to increase seed availability the year of release. Finally, OCIA and OFSS increased capacity to ensure an adequate, steady supply of foundation and registered seed.

Results
Wheat acres sown to registered seed for sale as certified seed the following year more than doubled (23,452 vs. 50,319 acres) from 2003 to 2012 and the number of varieties available to choose from increased from 19 to 16. Production of breeder and foundation seed during this time period has increase accordingly to meet demand. For example, there were 344 bushels of foundation "Duster" available in 2006, the year of its release. In contrast, there were 3,142 bushels of foundation "Gallagher" available for planting when it was released in 2012. This means more bushels of improved varieties in more seedsmens' hands more quickly. Planting of certified seed by farmers and ranchers has increased as well. Over the past five years acres planted to certified seed of OSU-developed varieties has increased from 112,000 to 785,000, assuming a one bushel per acre seeding rate.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #9

1. Outcome Measures

Drought Probability Assessment in Oklahoma

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Drought costs are estimated to vary from $6 to 8 billion per year in the United States; however, single events can cause losses as high as $39 billion. Accurate assessment of seasonal patterns in drought probability is important because if the crop cycle can be matched with periods when drought is less likely to occur, yield losses due to drought may be reduced. Current drought probability assessment methods are typically based on long-term atmospheric data such as rainfall and maximum and minimum temperatures. No existing methods use actual soil moisture measurements to assess drought probabilities. We hypothesized that, when long-term soil moisture data are available, they can be used to create soil water deficit-based drought probability assessments, which would be more reliable than those based on the atmospheric data alone.

What has been done
Fifteen years of daily precipitation, air temperature, and soil moisture measurements for eight Mesonet stations across Oklahoma were analyzed to calculate the probability of water deficits sufficient to cause plant water stress for each day of the growing season. For the new soil water deficit method, the drought threshold was set at 50% depletion of the soil?s total available water capacity. For the atmospheric water deficit method, a previously proposed 50 mm (2 inch), 7-day cumulative deficit was used.

Results
Drought probability values calculated by the atmospheric method were unreasonably low and consistently lower than probabilities estimated by the soil water deficit method. The performance

of the atmospheric method was improved by changing the threshold to 37 mm (1.5 inch) or by changing to a 15-day cumulative deficit. The new soil water deficit-based method gave plausible and consistent results when applied to both the 0- to 40- and 0- to 80-cm soil layers (16 or 32 inches) and should be utilized when long-term soil moisture data are available. This research was recently published in Agronomy Journal and has been the subject of recent press releases, a radio interview, and an invited presentation in the Oklahoma Winter Crop School.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #10

1. Outcome Measures

Best management practices for pasture recovery following drought.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Of the 8 million acres of introduced forages grown in Oklahoma, nearly all were negatively impacted through the excessive heat, prolonged drought, and heavy grazing pressure during the drought of 2010-2012. Even when growing conditions return to normal, lingering effects on pasture recovery related to drought will remain. Most notable of these will likely be reduced persistence, couple with slower regrowth.

What has been done
During 2012, a total of 11 Pasture Recovery Following Drought programs covering 13 counties were held to address specifics of pasture recovery due to extreme drought conditions using weed control, fertilization, and grazing deferment. Five hundred nineteen surveys were distributed with 193 completed (37% return rate). Conservative estimates suggest that forage managers of nearly 500,000 acres of introduced forage and pasture production in Oklahoma attended one of these programs. These acres represent approximately 5% of the total acreage devoted to the production and management of introduced pastures in Oklahoma.

Results
Survey respondents assessed that 79% of the introduced pastures in Oklahoma suffered moderate to severe drought damage with an average forage production loss of $136 per acre. This resulted in estimated forage and pasture losses during 2011 at $26 million just for the 37% who completed the survey. Across Oklahoma, a conservative estimate of total forage losses during 2011 of $1 billion is possible. Based on drought damage and the uncertainty of pasture recovery, 99% of those who responded to the survey indicated plans to use information they learned at one of these meetings. Over 95% indicated plans to use some combination of weed control, fertilization, and grazing deferment as their primary tools for pasture recovery. Likewise, 95% of those who responded to the survey indicated that they planned to either maintain or decrease herd size during 2012. Forage producers valued this program at $90 per acre. Thus, the economic impact of this program was valued at $17.7 million by those attending one of the 11 county programs. The Pasture Recovery Following Drought program can recover $650 million of drought-damaged forage and pasture in Oklahoma.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems

Outcome #11

1. Outcome Measures

Agricultural Testing Reduces Production Costs and Minimize the Impact of Agriculture on the Environment

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agricultural testing is needed by all producers to improve their profits and by Extension personnel to enhance their educational effectiveness. For example, soil testing has been proven to be one of the most important Best Management Practices (BMP) to improve nutrient use efficiency. However, many producers routinely fertilize their fields without testing the soil. It is possible to

apply unneeded fertilizer or animal manure if the nutrient status of cropland or pasture is unknown. This not only costs producers money, but the additional nutrients may enter water supplies and cause environmental problems. On the other hand, applying inadequate fertilizer could reduce yields and decrease profits. One of the major reasons for farmers not performing soil and other agricultural tests is the lack of understanding of their importance or the lack of confidence in test results.

What has been done
The Oklahoma State University Soil, Water and Forage Analytical Laboratory analyzed over 60,000 various samples for thousands of farmers, ranchers, homeowners, and researchers in a timely fashion. Farmers and homeowners use those results to guide their fertilizer application. Extension educators used the information we provided to enhance their outreach activities.

Results
Each year, we directly serve thousands urban and rural clientele and millions of acres of land are impacted. Test results are used by producers to formulate their fertilizer program, especially to develop animal waste management plans. Our timely soil testing and manure analyses have facilitated waste nutrient management plan development for poultry producers and other animal feeding operations (AFOs) mandated by state and federal regulations. The recommendations from the lab have increased nutrient use efficiency; therefore, the yields of crop production for producers who use soil testing should be improved while the costs of fertilizer use decrease. Soil test has proven to save $5 to $15/acre in nitrogen cost by crediting residual nitrate nitrogen. It could potentially save farmers $20 million if just 2 million acres are soil tested. The impact of agriculture on the environment as a non-point source should also be greatly reduced by following soil test recommendations and applying the right amount of nutrients at the right time.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems

Outcome #12

1. Outcome Measures

Improved Chicken Litter Handling and Transport

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The poultry industry has an economic importance in Eastern Oklahoma, serving as a major source of employment in rural areas and often a more profitable alternative to traditional agricultural enterprises in the region. Most of these poultry operations are concentrated animal feeding operations (CAFOs). Poultry CAFOs are supported by the import of animal feed containing nutrients such as nitrogen (N), phosphorus (P), and potassium (K); these nutrients are then exported from the farm in the form of agricultural products. However, much of the nutrients imported with the feed will remain on the farm in the form of manure. There hence lies a need to reduce litter mass with little monetary and labor inputs for the purpose of reducing litter transport costs and increasing hauling distances. The objectives of this study were to: (i) determine to what degree an alternative litter storage process (composting) designed to promote C degradation would decrease mass and affect litter properties including nutrient concentrations and carbon forms, and; (ii) conduct an economic analysis of this storage process in the context of transporting litter from poultry dense watersheds to areas deficient in soil P.

What has been done

Results
Our published results suggest that composting chicken litter will reduce its mass by about 20 percent. This is expected to result in a savings of over $35 million over the next 20 years in subsidies, transportation costs, and reduced fertilizer expenditures. Our on-going research is estimating the impact on energy savings.

Our research on the application of poultry litter to sweet sorghum indicates that litter can be an economically viable substitute for inorganic fertilizers when applied at nutrient equivalent rates. According to our estimates, poultry litter can be profitably shipped up to 100 miles when compared to commercial fertilizer. Moreover, extending the use of poultry litter as a fertilizer source will enable producers to fertilize sweet sorghum, a crop that is usually left non-amended. Poultry litter, when field applied at the optimal rate will provide a per acre impact of $75 per acre compared to non-amended fields. Helping improve the profitability of sweet sorghum production will have a positive impact on the biofuel industry in Oklahoma by reducing the cost of biofuel stocks. Increasing the off-site use of poultry litter will also provide substantial environmental impacts to Oklahoma by reducing the potential for phosphorus runoff into its waterways.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
205	Plant Management Systems

Outcome #13

1. Outcome Measures

Increasing phosphorus use efficiency of wheat

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Demand for phosphorus (P) is steadily rising and the P reserves relied on are decreasing in both quantity and quality. These reserves are predicted to reach near exhaustion within the next 46-60 years. In addition, global demand for cereal crops is estimated to increase 31% by 2030. To meet this demand it is imperative that resource efficiency, especially P-use efficiency, of all major crops be increased. Failing to do so could lead to the exploitation of marginal land and the resulting negative environmental and social consequences.

What has been done
Studies were initiated to screen for P-use efficiency among 22 wheat accessions in low P acid and calcareous soils. In addition, a method was developed for differentiating between P-uptake efficiency (i.e., the ability to uptake relatively non-available soil P forms) and P-utilization efficiency (i.e., the ability to produce biomass with little P uptake). Studies have also been initiated for examining accession mechanisms that increase P solubility in the rhizosphere, which contributes to P-uptake efficiency.

Results
Phosphorus-use efficiency screening has been completed for all 22 wheat accessions. Chisolm-S and MO4*5109 were the two most P-uptake efficient accessions under acidic conditions, while Garrison, Fuller, and Ruby Lee were the most P-utilization efficient. Among calcareous soils, SD0669 and P03207A-7 were the most P-uptake efficient while W98008J1 was the most P-utilization efficient accession. Rhizosphere studies have been completed on these cultivars; results will provide information about how P-uptake efficient accessions are able to make soil P more available for uptake. This information will help breeders in developing more P-use efficient cultivars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #14

1. Outcome Measures

Feasibility analysis of a market based incentive program for decreasing N2O emissions in Oklahoma through improved nutrient management.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nitrous oxide (N2O) is greenhouse gas that can be produced by the application of nitrogen fertilizers, among other things. Incentive-based solutions need to be evaluated as potential methods to reduce N2O emissions from agricultural operations.

What has been done
A team was assembled in 2012 to evaluate the potential for an incentive based solution to reduce N2O emissions from agricultural operations. The Environmental Quality Incentive Program (EQIP) through the Natural Resources Conservation Service (NRCS) was explored as an avenue for providing incentives.

Results
It was determined that a market-based incentive program for improved nutrient management to decrease N2O emissions from Oklahoma cropland would result in an infusion of potentially $1.5 million of EQIP funds to the State. This infusion was provided to allow for on farm assessment of NRCS tools that have recently been developed to assess farm greenhouse gas (GHG) budgets. The Project will also evaluate the feasibly of a greenhouse gas credit program based on reductions in N2O emissions resulting from sensor-based N management and cover crop management. The total EQIP funding provided to Oklahoma in 2013 will be determined by producer participation in Oklahoma as well as in other participating State.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation

Outcome #15

1. Outcome Measures

Swine Effluent Project

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Oklahoma's rapid growth in animal population and density has heightened concerns over animal waste management. Swine waste has increased from 2834 MT in 1992 to over 178,313 MT in 2007. In the Oklahoma Panhandle, nearly all of the swine waste is stored in open-air lagoon systems. When properly applied and remunerative, swine lagoon effluent (SE) can be used as manure with minimal environmental and nuisance concerns, such as odor. Swine manure benefits producers by reducing waste management costs and the need for chemical fertilizers because SE contains multiple essential crop nutrients. By recycling nutrients, animal manures enhance sustainable agriculture and improve overall animal production efficiency.

What has been done
A long-term field experiment was conducted between 1995 and 2007 at the Oklahoma Panhandle Research and Extension Center (OPREC) near Goodwell, Oklahoma. Field experiments were conducted to evaluate the long-term effects of equivalent nitrogen rates of swine lagoon effluent (SE), beef manure (BM), and commercial fertilizer on the yield and economic returns of irrigated corn (Zea mays L.) grown on calcareous Gruver silt loam soil. A randomized, complete-block, split-plot design with three replications was used to test the main effects of N source and equivalent N application rates of 56, 168, and 504 kg N ha-1.

Results

Study results revealed that the two organic fertilizers tested in the experiment, BM and SE, are adequate substitutes for chemical fertilizers. No significant difference in corn yield was found between the organic and chemical sources of nutrients, and BM and SE generated higher economic returns than AA. The findings were generally robust across the wide range of prices encountered during the experiment, although neither SE nor BM would not have been as profitable as AA during the cheap energy prices experienced in the late 1990s (1998-2000). Hence, this study is in agreement with previous research that found animal manures to be adequate, and oft en remunerative, substitutes for chemical sources of N. Site-specific conditions such as weather, animal waste management practices, and soil properties should be considered before results can be generalized to other locations outside the Oklahoma Panhandle.

The results of the study were picked up by the agricultural media. An article in Science Daily was recently published that discussed the study findings, bring the results to the broader farming community. See the following reference: "Manure Provides Higher Returns Than Chemical Fertilizers, Economist Says." Science Daily. Available at http:\\www.sciencedaily.com.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
205	Plant Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Public Policy changes
- Government Regulations

Brief Explanation

Severe drought the last two years have caused problems related to crop research and demonstration. It has also caused numerous Extension meeting and conferences to help producers to cope and adapt.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

A survey was mailed to 9,500 Oklahoma farmers relating to **Tillage Practices**. It was found that on average, Oklahoma farms that use no till (NT) methods crop more than twice as many acres as those that use intensive tillage (IT) methods. Fifty percent of the farms that use NT plant more than 1,000 acres to annual crops compared to 16 % the farms that use IT. The NT farms have more diversified cropping operations and use crop rotations. The IT farms plant more than 90 percent of their annual crop acres to wheat and seldom rotate to

other crops.

During 2012, a total of 11 **Pasture Recovery Following Drought** programs covering 13 counties were held to address specifics of pasture recovery due to extreme drought conditions using weed control, fertilization, and grazing deferment. Five hundred nineteen surveys were distributed with 193 completed (37% return rate). Conservative estimates suggest that forage managers of nearly 500,000 acres of introduced forage and pasture production in Oklahoma attended one of these programs. These acres represent approximately 5% of the total acreage devoted to the production and management of introduced pastures in Oklahoma.

Survey respondents assessed that 79% of the introduced pastures in Oklahoma suffered moderate to severe drought damage with an average forage production loss of $136 per acre. This resulted in estimated forage and pasture losses during 2011 at $26 million just for the 37% who completed the survey. Across Oklahoma, a conservative estimate of total forage losses during 2011 of $1 billion is possible. Based on drought damage and the uncertainty of pasture recovery, 99% of those who responded to the survey indicated plans to use information they learned at one of these meetings. Over 95% indicated plans to use some combination of weed control, fertilization, and grazing deferment as their primary tools for pasture recovery. Likewise, 95% of those who responded to the survey indicated that they planned to either maintain or decrease herd size during 2012. Forage producers valued this program at $90 per acre. Thus, the economic impact of this program was valued at $17.7 million by those attending one of the 11 county programs. The Pasture Recovery Following Drought program can recover $650 million of drought-damaged forage and pasture in Oklahoma.

Key Items of Evaluation