

**V(A). Planned Program (Summary)**

**Program # 1**

**1. Name of the Planned Program**

Global Food Security and Hunger

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	10%	10%	15%	33%
205	Plant Management Systems	10%	10%	10%	0%
216	Integrated Pest Management Systems	15%	10%	10%	0%
301	Reproductive Performance of Animals	0%	0%	0%	33%
311	Animal Diseases	10%	10%	10%	0%
503	Quality Maintenance in Storing and Marketing Food Products	5%	10%	5%	0%
601	Economics of Agricultural Production and Farm Management	10%	10%	10%	0%
602	Business Management, Finance, and Taxation	10%	10%	10%	0%
604	Marketing and Distribution Practices	10%	10%	10%	0%
608	Community Resource Planning and Development	10%	10%	10%	0%
704	Nutrition and Hunger in the Population	10%	10%	10%	0%
723	Hazards to Human Health and Safety	0%	0%	0%	34%
	<b>Total</b>	100%	100%	100%	100%

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2014	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	26.0	4.0	16.0	1.0
<b>Actual Paid</b>	24.0	0.0	15.0	7.7
<b>Actual Volunteer</b>	0.0	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
1194456	474795	1561932	595668
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1194456	474795	1561932	574139
1862 All Other	1890 All Other	1862 All Other	1890 All Other
1022713	0	89950	0

## V(D). Planned Program (Activity)

### 1. Brief description of the Activity

- UME, MAES, and AES will have a combined focus to ensure that Maryland agriculture and food production will be sustainable and profitable and produce a safe, abundant, affordable, and accessible food supply.
  - Research coordinated through MAES and AES on crop and animal breeding, specialty crops, market analysis, economic sustainability, and policy analysis will be performed, while UME will be involved in local and regional efforts to assist agricultural and natural resource entrepreneurs.
  - Research conducted through MAES, AES, and UME will generate vital information to increase productivity using genomics, breeding, and adaptation of alternate crops with economic and environmental sustainability.
  - Through UME's Impact Teams and MAES, and AES's research projects, the following planned program activities will be emphasized: Integrated Pest Management (IPM); Value Added & Specialty Crops; Grow It-Eat It; Annie's Project; Best Management Practices in Crop and Animal Agriculture; Technologies for the Genetic Improvement of Crops and Animals; Agronomic Fruit & Vegetable Production; Dairy Analysis; and Small/Beginning Farmers Program.
    - On-line educational programs, field trials, twilight tours, seminars, workshops, farm visits, on-farm research & demonstrations and individual farm consultations will be used to educate Maryland farmers, Agriculture industry professionals, Soil Conservation District personnel, USDA-NRCS conservationists and extension faculty.
    - New research and technologies developed by the MAES and AES will be transferred via UME on-farm demonstrations and twilight tours.
    - Training programs will be developed to improve nutrient management practices, IPM, diagnostic skills, identification and control of invasive species, water management practice improvements and reductions, biosecurity and animal health.

### 2. Brief description of the target audience

- Food Stamp Recipients
- Limited Income Families
- School age youth on free or reduced-cost meals

- New immigrants
- Students
- Plant growers and breeders
- Retailers
- Producers
- Female farmers
- Beginning farmers
- Socially disadvantaged farmers
- Small farms operators

**3. How was eXtension used?**

UME faculty participates actively in the Goat Industry Community of Practice by participating in the "Ask The Expert" feature. Also, contributes in uploading content on the use of small ruminants to manage unwanted vegetation.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	35833	7685793	26140	160000

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

Year: 2014  
 Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2014	Extension	Research	Total
<b>Actual</b>	22	51	0

**V(F). State Defined Outputs**

**Output Target**

### **Output #1**

#### **Output Measure**

- IPM (Green Industry & Agronomic Crops): Fact sheets, short courses, workshops, field trials, twilight tours, curriculum, websites, grants awarded.

<b>Year</b>	<b>Actual</b>
2014	983

### **Output #2**

#### **Output Measure**

- Community Resource & Economic Development: Publications, seminars, workshops, grants and curriculum developed.

<b>Year</b>	<b>Actual</b>
2014	36

### **Output #3**

#### **Output Measure**

- Biosecurity, BMP's and Animal Health: In-service training, seminars, publications, grants, presentations, websites, research trials, and workshops.

<b>Year</b>	<b>Actual</b>
2014	53

### **Output #4**

#### **Output Measure**

- Pasture Management, Rotational Grazing & Dairy Analysis: Pasture walks, variety trials, in-service training, grants, publications, budgets, websites, farm analysis performed & workshops

<b>Year</b>	<b>Actual</b>
2014	323

### **Output #5**

#### **Output Measure**

- Grow It-Eat It: Number of workshops, publications and grants.

<b>Year</b>	<b>Actual</b>
2014	154

**Output #6**

**Output Measure**

- Agronomic, Fruit & Vegetable Crop Production: Number of variety trails, twilight tours, seminars, workshops, publications, and grants.

<b>Year</b>	<b>Actual</b>
2014	138

**Output #7**

**Output Measure**

- Small/Beginning Farmers and Annie's Project: Number of workshops, number of participants; publications, grants and new partnerships.

<b>Year</b>	<b>Actual</b>
2014	128

**Output #8**

**Output Measure**

- Number of research projects

<b>Year</b>	<b>Actual</b>
2014	0

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	IPM (Green Industry & Agronomic Crops): Number of IPM scouts and producers that can identify threshold level; number of pest management programs; Number implementing research based recommendations; certification in Pesticide Safety; field trails.
2	Community Resource & Economic Development: Number of business people, advisory groups, development agencies, rural leaders and potential farmers interested in developing new AGNR businesses; Business and marketing plans developed; Number of Communities integrating UME information for land use decisions and improved growth management concepts; Pubs developed; Number of people downloading AGNR enterprise information from MREDC web site; and Regional collaborations.
3	Bio-security, BMPs and Animal Health: Number of educational seminars held for producers, allied industry personnel and government workers; number of producers implementing biosecurity and BMP measures; new training curriculum developed.
4	Farm Management & Agricultural Profitability: Number of farmers/livestock owners adopting best management practices; Number of farmers/livestock owners adopting rotational grazing strategies; Number farmers (Dairy, Beef, Equine, Sheep/Goats) increasing profitability as a result of these programs; new variety trails; Extension, NRCS and SWCD personnel trained; new practices (BMPs & rotational grazing) recommended; and number of dairy farmers implementing changes as a result of Dairy Analysis.
5	Home Food Production: Number of Master Gardeners trained; Number of people establishing new back yard gardens; number of new community supported agriculture (CSA) gardens established.
6	Agronomic, Fruit & Vegetable Crop Production: Number of producers attending programs, twilight tours and workshops; Number producers/growers developing basic diagnostic skills in identifying invasive insects, diseases and weeds; Number of producers who write and update their own nutrient management plan; Number of producers adopting production management practices that will improve their profitability; Number of producers who increase profitability; Number adopting field research practices dealing with improved crop varieties, invasive species, weeds and diseases; Number adopting methods to be more efficient in their water use in livestock and crop production.
7	Small/Beginning Farmers (Agronomic & Green Industry): Number of new farm enterprises established as a result of our programs; Number successfully completing Annie's Project; Number of women who have implemented change in their family farming operation after attending Annie's Project; Number of new/beginning farmers and Annie's Project graduates participating in additional UME AGNR programs, twilight tours and workshops; and number of farmers who become certified in nutrient management planning and/or pesticide safety.
8	Research: Bovine Embryo Nutrient Utilization and Viability
9	Research: Global Survey of Snail2 Target Genes During Avian Growth and Development
10	Research: Deep Soil Nitrogen: A Resource for Profitability and Stewardship

11	Research: Development of Effective Vaccine Against Porcine Reproductive & Respiratory Syndrome Virus (PRRSV)
12	Research: The Environmental Concerns of Arsenic Additives in Poultry Litter
13	Research: Abiotic and Biotic Drivers of Productivity and Diversity in Worldwide Grasslands
14	Research: Biological Invasions and Sustainability of Managed Ecosystems
15	Research: The Influence of Cover Crops and Tillage on Soil Quality, Greenhouse Gas Emissions, Pest Community Dynamics, and Economics of Transitioning to Organic Farming
16	Research: Surface Properties, Transport, and Delivery of Protein-based Nanoparticles: Using Cationic $\beta$ -lactoglobulin Nanoparticles as a Model System.

**Outcome #1**

**1. Outcome Measures**

IPM (Green Industry & Agronomic Crops): Number of IPM scouts and producers that can identify threshold level; number of pest management programs; Number implementing research based recommendations; certification in Pesticide Safety; field trails.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2014	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Pest management is a critical issue for agricultural producers. Management of pests must be done in a way which is economically feasible and environmentally sustainable. Over reliance/improper use of pesticides can result in development of resistance, residues on agricultural products, crop damage and damage to non target organisms such as beneficial

insects and also exposure of agricultural workers and their families.

#### **What has been done**

Workshops were conducted for farmers on how to monitor insects, weeds, and diseases of field crops as a method of assessing the potential for economically important crop damage. Farmers learned techniques for implementing IPM by emphasizing a systems approach to production and pest management of field crops and the fundamentals of safe pesticide application that enable them to obtain certification or recertification as a private pesticide applicator.

#### **Results**

50 producers received up to date IPM information which assisted them in managing pests on their farms using methods which were effective, economically feasible, and environmentally sustainable.

28 producers received training which allowed them to renew private applicator certifications, assuring that they could continue applying pesticides safely while protecting the environment and in accordance with IPM principles. A positive impact of this education in 2014 was that there were only two complaints against private agricultural pesticide applicators (out of 40 total complaints) in the state of Maryland for the year.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
205	Plant Management Systems
216	Integrated Pest Management Systems
601	Economics of Agricultural Production and Farm Management
723	Hazards to Human Health and Safety

#### **Outcome #2**

##### **1. Outcome Measures**

Community Resource & Economic Development: Number of business people, advisory groups, development agencies, rural leaders and potential farmers interested in developing new AGNR businesses; Business and marketing plans developed; Number of Communities integrating UME information for land use decisions and improved growth management concepts; Pubs developed; Number of people downloading AGNR enterprise information from MREDC web site; and Regional collaborations.

##### **2. Associated Institution Types**

- 1862 Extension
- 1890 Extension
- 1862 Research

##### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2014	0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Farming is a unique business that has strong ties to family, values and land. These strong ties lead to the need for outreach and education on risk management topics such as financial planning, estate planning, marketing, communication, computer programs, budgeting, insurance and much more. As profit margins slim and expenses rise the importance of mitigating these risks has increased.

#### What has been done

The MidAtlantic Women in Agriculture program engages, educates and empowers women on common issues in risk and farm management through a variety of learning environments. Classes include "Annie's Project" and "Managing for Today and Tomorrow." A Regional Women in Agriculture Conference is held annually and attended by approximately 175 people.

#### Results

Participants leave the program with a high intent to write business and marketing plans, use computers, check credit reports, prepare financial statement, update estate plans, and positively increase community and family relations. Writing business and marketing plans was an action that participants wanted to do (97%) and 39% actually followed through. Checking credit reports, updating estate plans, and positively increasing family communications were the actions that the greatest majority of participants engaged in.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices
608	Community Resource Planning and Development

### Outcome #3

#### 1. Outcome Measures

Bio-security, BMPs and Animal Health: Number of educational seminars held for producers, allied industry personnel and government workers; number of producers implementing biosecurity and BMP measures; new training curriculum developed.

#### 2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

### 3a. Outcome Type:

Change in Action Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2014	2

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

For the last 25 years, rapid changes in demographics in the USA have resulted in a demand for lamb and chèvon (goat meat). According to a 2009 Agricultural Statistics, it has been estimated that more than 50 million people have a preference for lamb and/or chèvon in the United States. Since 1984, a steady increase on the number of goats slaughtered in USDA inspected plants has not been able to match the chèvon demand and there is a deficit when compared to the goat inventory in the nation. For example by January 1, 2013, there were 2.81 million goats in the USA. Until 2009, meat goats were the fastest- growing sector on the three types of goats (milk, fiber and meat); however, declining production and fairly stable consumption allows for importation of chèvon. With per capita lamb and mutton consumption fairly stable, imports have offset the decline in domestic production. Lamb and mutton imports, which currently account for nearly half of U.S. consumption, are mainly from Australia (about 68-70%) and New Zealand (about 30-32%). USA sheep and goat producers have a great opportunity if they target the demand and the proximity to large concentrations of chèvon consumers in Washington, DC; New York; Philadelphia; Baltimore; and Newark enhancing farm diversity and sustainability. Sheep and goat production is a great opportunity for small farmers to sustainably target lamb and chèvon demand. However, sheep and goat producers face at least two main challenges: a) gastrointestinal parasites (mainly *Haemonchus contortus* or barber pole worm) and b) reproductive performance, sheep and goats are seasonal breeders and it is hard to target market opportunities without any estrus synchronization practices. In general sheep and goat producers assume that sheep and goats are "small cows" and neglect to obtain nutritional guidelines for their livestock. UME sheep and goat specialists train farmers on the recommended feeding and management practices, integrated parasite control, and breeding techniques including the use of controlled internal drug release (CIDR) devices.

#### What has been done

Two workshops titled "Be smart? Drench Smart?", were conducted in Southern Maryland and at UMES with 30 participants. The workshops emphasized the use of the FAMACHA score card to identify critically parasitized animals for treatment. Such targeted treatment is aiming to slow progress of commercial anthelmintic resistance. In addition, alternative practices were proposed

to the workshop participants to reduce the sheep and goats acquiring parasite eggs from pasture or holding facilities. Participants were also educated on sheep and goat nutritional requirements since a core practice to avoid livestock death is an adequate plane of nutrition. Students, sheep and goat producers, and agriculturists have been instructed on the breeding seasonality of sheep and goats. Also, an alternative has been proposed by using CIDRs to synchronize estrus and target peak lamb and chèvon demand periods to enhance small farm operators' income.

## Results

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
311	Animal Diseases
601	Economics of Agricultural Production and Farm Management

### Outcome #4

#### 1. Outcome Measures

Farm Management & Agricultural Profitability: Number of farmers/livestock owners adopting best management practices; Number of farmers/livestock owners adopting rotational grazing strategies; Number farmers (Dairy, Beef, Equine, Sheep/Goats) increasing profitability as a result of these programs; new variety trails; Extension, NRCS and SWCD personnel trained; new practices (BMPs & rotational grazing) recommended; and number of dairy farmers implementing changes as a result of Dairy Analysis.

#### 2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

#### 3a. Outcome Type:

Change in Action Outcome Measure

#### 3b. Quantitative Outcome

Year	Actual
2014	0

#### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**

{No Data Entered}

**What has been done**

{No Data Entered}

**Results**

{No Data Entered}

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
301	Reproductive Performance of Animals
503	Quality Maintenance in Storing and Marketing Food Products
601	Economics of Agricultural Production and Farm Management

**Outcome #5**

**1. Outcome Measures**

Home Food Production: Number of Master Gardeners trained; Number of people establishing new back yard gardens; number of new community supported agriculture (CSA) gardens established.

**2. Associated Institution Types**

- 1862 Extension
- 1890 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

## What has been done

### Results

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
216	Integrated Pest Management Systems
503	Quality Maintenance in Storing and Marketing Food Products

#### Outcome #6

##### 1. Outcome Measures

Agronomic, Fruit & Vegetable Crop Production: Number of producers attending programs, twilight tours and workshops; Number producers/growers developing basic diagnostic skills in identifying invasive insects, diseases and weeds; Number of producers who write and update their own nutrient management plan; Number of producers adopting production management practices that will improve their profitability; Number of producers who increase profitability; Number adopting field research practices dealing with improved crop varieties, invasive species, weeds and diseases; Number adopting methods to be more efficient in their water use in livestock and crop production.

##### 2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2014	0

##### 3c. Qualitative Outcome or Impact Statement

###### Issue (Who cares and Why)

Despite advances in organic weed management, organic growers consistently rank weeds as a primary production-related issues. Weeds continue to be a problem in non-competitive crops like vegetables, and as a result, farmers often rely on physical disturbances such as tillage to manage

weed. These repeated soil disturbances negatively effects soil quality and health parameters. The competing interests for weed control and soil quality leave organic producers with few viable options for ecologically-based weed management. Organic herbicides are too expensive if use over an entire field.

#### **What has been done**

This research project, "The Influence of Cover Crops and Tillage on Soil Quality, Greenhouse Gas Emissions, Pest Community Dynamics, and Economics of Fields Transitioning to Organic Farming" has introduced an integrated weed management protocol that limits the tillage activity and significantly lowers the amount of organic herbicide needed while creating healthy soil conditions and crop yields.

#### **Results**

The adoption of minimum till practices will result in lower greenhouse gas emission and machinery input compared to conventional tillage practices with and without the use of black plastic mulches. Specific research goals include to: 1) examine the direct and indirect effects of cover cropping and reduced tillage on soil quality and soil health; 2) study how different tillage systems affect weed community dynamics; 3) determine how these practices affect net greenhouse gas emissions; 4) evaluate the cost effectiveness and profitability of reduced tillage practices; and 5) provide organic vegetable producers a comprehensive best management practice plan. These goals parallel ORG priorities of documenting and understanding the effects of organic practices on soil quality and greenhouse gas emission.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
216	Integrated Pest Management Systems
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
608	Community Resource Planning and Development
723	Hazards to Human Health and Safety

#### **Outcome #7**

##### **1. Outcome Measures**

Small/Beginning Farmers (Agronomic & Green Industry): Number of new farm enterprises established as a result of our programs; Number successfully completing Annie's Project; Number of women who have implemented change in their family farming operation after attending Annie's Project; Number of new/beginning farmers and Annie's Project graduates participating in additional UME AGNR programs, twilight tours and workshops; and number of farmers who become certified in nutrient management planning and/or pesticide safety.

##### **2. Associated Institution Types**

- 1862 Extension
- 1890 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

**What has been done**

**Results**

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems
216	Integrated Pest Management Systems
311	Animal Diseases
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices
608	Community Resource Planning and Development

**Outcome #8**

**1. Outcome Measures**

Research: Bovine Embryo Nutrient Utilization and Viability

**2. Associated Institution Types**

- 1862 Research

### 3a. Outcome Type:

Change in Condition Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2014	0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Despite decades of research, current in vitro embryo production protocols are not optimal as demonstrated by poorer embryo quality, aberrant embryo metabolism, and lower pregnancy rates. Early embryonic death and inadequate maternal recognition of pregnancy are contributing factors to poor fertility in high producing dairy cows.

#### What has been done

Bovine embryos have been cultured under varying nutrient conditions and samples collected for analyzed by GC-Mass spectrometry. The preliminary results demonstrate that: 1) this approach is capable of measuring substrate use and metabolic pathway fluxes in as few as 4 embryos, and 2) that substrate balance in the media has a profound influence on pathway activities (e.g., glycolysis, PPP, PC, PDH, and ME), and on the routes and extents that media substrates are metabolized. Results were presented at a national meeting (SSR 2014).

#### Results

Unraveling the metabolic basis of normal early embryo development will provide significant benefits to human and animal reproductive health. Improved embryonic competency following in vitro production and cryopreservation would stimulate the industry by lowering costs, especially those related to recipient management.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals

### Outcome #9

#### 1. Outcome Measures

Research: Global Survey of Snail2 Target Genes During Avian Growth and Development

#### 2. Associated Institution Types

- 1862 Research

### 3a. Outcome Type:

Change in Condition Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2014	0

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

The neural crest, a population of migratory cells derived from the future central nervous system in the developing chicken embryo, gives rise to a diverse range of cell types, including most of the peripheral nervous system, melanocytes, the craniofacial skeleton, and parts of the heart. As such, the proper formation of neural crest cells is critical for the overall growth and development of the chicken embryo into the adult organism.

#### What has been done

Research results to date show that aN-catenin works through Cadherin-7 to promote productive interactions with placode cells, while Annexin A6 may serve as a cytoskeletal scaffolding molecule and direct changes in actin to permit placode cell motility and associations with neural crest cells. In addition, researchers have discovered that the transmembrane tight junction protein claudin-1 influences neural crest cell emigration. Claudin-1 depletion or overexpression enhances or impedes neural crest cell emigration, respectively, and does this independently of affecting adherens junctions or the neural tube basal lamina.

#### Results

These results are the first to describe a role for Annexin proteins in the neural crest. Now being investigated is how Annexin A6 modulates neural crest cell cadherin levels. Researchers will next examine the temporal order of how these proteins are downregulated during neural crest cell EMT. Furthermore, we demonstrated that the Snail2 target aN-catenin is expressed later by migratory neural crest cells as they interact with placode cells to form the cranial trigeminal ganglia. Additional molecules expressed initially by neural crest cells were also investigated, including the Wnt target Annexin A6. The test results showed that this protein is lost by early migratory neural crest cells but is later expressed in placode cells during their induction, migration and interaction with neural crest cells during trigeminal ganglia assembly.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals

## **Outcome #10**

### **1. Outcome Measures**

Research: Deep Soil Nitrogen: A Resource for Profitability and Stewardship

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Condition Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	0

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

While still in the early stages, the researchers are aiming to develop early establishment of cover crops in systems that prevent 200 kg/ha or more of N loss and return a significant part of that captured N in a time and form that the following cash crop can use, thus reducing the needed fertilizer applications in spring.

#### **What has been done**

Research is underway to: measure size of deep N pool at end of soybean and corn season; evaluate the N capture ability of cover crops with early establishment (4-5 weeks before cash crop harvest), including aerial seeding; evaluate the utility of 1 or 2 irrigation passes immediately after aerial seeding in ensuring a vigorous early cover crop stand; test the validity of an on-the-spot nitrate-N analysis at seeding time using a new nitrate ion-selective electrode to predict the fall cover crop growth; 4) test the need for a small starter N application to allow cover crops to catch a larger amount of deep N; and evaluate the availability of the captured N (and S) to spring-planted cash crops.

#### **Results**

Preliminary data suggests that many cropped soils contain 100 to 400 kg mineral N/ha in the upper 2 meters. To capture this N before it leaches to the groundwater, cover crops must be established early enough in late summer/fall to root to 2 mters and produce significant biomass in fall. The on-farm trials will generate important information on how to use cover crops for improved nutrient cycling and profitability

### **4. Associated Knowledge Areas**

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<b>KA Code</b>	<b>Knowledge Area</b>
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102	Soil, Plant, Water, Nutrient Relationships
601	Economics of Agricultural Production and Farm Management

### **Outcome #11**

#### **1. Outcome Measures**

Research: Development of Effective Vaccine Against Porcine Reproductive & Respiratory Syndrome Virus (PRRSV)

#### **2. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

Change in Condition Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	0

#### **3c. Qualitative Outcome or Impact Statement**

##### **Issue (Who cares and Why)**

PRRSV has been causing enormous losses to the swine industry across the world since it was found in early 1990s. This current strategy and vaccines are inadequate to control PRRSV infection. The goals of this study are to explore a novel PRRSV strain that the research team discovered for vaccine development. The feature of this strain is induction of type I interferons, major component in innate immunity. PRRSV is known to inhibit interferon signaling. This strain is expected to enhance immune response and can be used as an improved vaccine against PRRSV.

##### **What has been done**

This strain has been attenuated in cultured cells by serial passaging in the laboratory. Its feature of interferon induction remains in the high passages of this strain. An animal experiment has been conducted to test the virulence and immunogenicity of the high passages. Virus neutralization and real-time PCR to analyse the pig serum samples is taking place.

##### **Results**

Completion of this project will generate a potential effective vaccine candidate against PRRSV. Further exploration of this strain will yield more information about its properties and application in vaccine development.

#### **4. Associated Knowledge Areas**

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<b>KA Code</b>	<b>Knowledge Area</b>
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311 Animal Diseases

## **Outcome #12**

### **1. Outcome Measures**

Research: The Environmental Concerns of Arsenic Additives in Poultry Litter

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	0

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

On May 22, 2012, then Maryland Governor Martin O'Malley signed a bill into law to ban the use of arsenic additives in poultry feed. This was the first such ban passed in the United States. This ban did not cover histostat which contains nitarsonic acid and is used for treatment of blackhead disease in poultry. On September 30, 2013 the USFDA announced that it was withdrawing approval of 3 of the 4 arsenic formulations used in animal feed including roxarsone, carbarsone and arsanilic. The USFDA is in the process of reviewing the fourth of these drugs, nitarsonic acid.

#### **What has been done**

A literature review was conducted in response to a request by the Environmental Matters and the Education, Health and Environmental Affairs Committees of the Maryland General Assembly to help in their discussions on whether to ban the use of arsenic additives in poultry food. The goal of the review was to summarize the literature on the environmental consequences of adding arsenic to poultry food.

#### **Results**

Arsenic added to poultry feed as roxarsone ends up in poultry litter. Fresh litter contains predominately roxarsone while aged litter contains predominately inorganic arsenic. Soil arsenic concentrations from long-term poultry litter applications can exceed Maryland arsenic soil background remediation standards. Due to continued soil accumulation, arsenic amended litter use as fertilizer is thought to be unsustainable. Surface applied roxarsone amended litter does not influence deep aquifer arsenic concentrations but is transported as inorganic arsenic to receiving waters and very shallow groundwater after precipitation. Arsenic in some receiving waters and sediments from agriculturally dominated watersheds have levels above established criteria.

Arsenic in fish and shellfish is mostly organic. Phosphorus based nutrient management will tend to limit PL application rates in areas that have over applied phosphorous relative to crop needs resulting in decreased rates of arsenic application and accumulation. Despite most arsenic in surface soils being tightly bound, as surface soils become more enriched in arsenic, the potential for downward movement increases but is limited in most soils due to the high capacity for binding of arsenic to clay minerals and oxides of iron and aluminum in subsoil horizons.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
723	Hazards to Human Health and Safety

#### Outcome #13

##### 1. Outcome Measures

Research: Abiotic and Biotic Drivers of Productivity and Diversity in Worldwide Grasslands

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Condition Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2014	0

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Working since inception (2007) with a global network of ecologists, dozens of parallel experiments have been set up in grassland ecosystems worldwide to tease apart the relative importance of climate, nutrient resources, and grazers in allowing plant species coexistence in grasslands.

###### **What has been done**

Using data from the global Nutrient Network, the researchers have challenged important ecological theory (the form of the productivity-diversity relationship) and provided evidence for mechanisms supporting other general theory (mechanisms of species coexistence). For example, the research has demonstrated that nutrient enrichment decreases grassland plant diversity, but herbivores increase diversity by reducing community dominance by the few and increasing light levels available to rare plants for photosynthesis and growth.

### Results

The grassroots network, called the "Nutrient Network" (nutnet.org), has been more successful than ever anticipated. There are now 80+ research sites on 6 continents participating in the network.

### 4. Associated Knowledge Areas

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

### Outcome #14

#### 1. Outcome Measures

Research: Biological Invasions and Sustainability of Managed Ecosystems

#### 2. Associated Institution Types

- 1862 Research

#### 3a. Outcome Type:

Change in Condition Outcome Measure

#### 3b. Quantitative Outcome

Year	Actual
2014	0

#### 3c. Qualitative Outcome or Impact Statement

##### Issue (Who cares and Why)

Research has shown that conservation tillage doubles the prevalence of insect-pathogenic nematodes that provide endemic controls of potential pest insects.

##### What has been done

Research at MAES facilities has investigated the impact of tillage practices on soil biodiversity and biological control; treatment and control options for the invasive small hive beetle *Aethina tumida*; and microbial and community ecology of introduced woodwasp *Sirex noctilio*.

##### Results

Work with *Sirex noctilio* has provided evidence fundamentally changing the understanding of its biology: the first evidence has been obtained of a tripartite symbiosis with fungal and bacterial mutualists for the larvae as they burrow through the xylem of pine trees. The fungus provides simple carbohydrates from cellulose and lignin, which then powers the energy-intensive process

of internal microbial nitrogen fixation.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
216	Integrated Pest Management Systems

#### Outcome #15

##### 1. Outcome Measures

Research: The Influence of Cover Crops and Tillage on Soil Quality, Greenhouse Gas Emissions, Pest Community Dynamics, and Economics of Transitioning to Organic Farming

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Condition Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2014	0

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Frequent soil disturbances resulting from production activities such as tillage or cultivation for land preparation or weed management can be detrimental to soil quality by negatively impacting physical, chemical, and biological soil properties. Cover cropping, in combination with reduced tillage, can reverse these negative effects and concurrently reduce insect and weed pests, production costs, and CO<sub>2</sub> emissions, while providing additional ecosystem services such as increasing nutrient-cycling organisms and soil biodiversity.

###### **What has been done**

The research is 1) examining the direct and indirect effects of cover cropping and reduced tillage on soil quality and soil health; 2) studying how different tillage systems affect weed community dynamics; 3) determining how these practices affect net greenhouse gas emissions; 4) evaluating the cost effectiveness and profitability of reduced tillage practices; and 5) providing organic vegetable producers a comprehensive best management practice plan.

###### **Results**

Thus, through this research, an integrated weed management protocol has been produced that limits the tillage activity and significantly lowers the amount of organic herbicide needed while creating healthy soil conditions and crop yields. Vegetable growers can get similar yields using minimal till compared to conventional till practices while reducing fuel use, production cost and green house gas emission. Minimal till practices such as no-till and strip-till when integrated with cover crops can be use as a legitimate practice for managing weeds that reduce the amount of chemical inputs required for managing pests. The strip-till treatment may still require herbicide use as part of an overall Integrated Weed Management plan but the total amount applied can be reduced by as much as 75% compared to spraying the entire field.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
216	Integrated Pest Management Systems

#### Outcome #16

##### 1. Outcome Measures

Research: Surface Properties, Transport, and Delivery of Protein-based Nanoparticles: Using Cationic  $\beta$ -lactoglobulin Nanoparticles as a Model System.

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Condition Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2014	0

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

The interplay among the drug, matrix, and environment plays a critical role in the behavior of drug-loaded nanoparticles in various physiological processes, all of which determine their stability and performance after oral administration.

###### **What has been done**

This research introduced a novel drug delivery system based on cationic-lactoglobulin (CBLG), which demonstrated satisfactory stability against digestion, high mucoadhesion, effective transport across the small intestine lining, low cytotoxicity, and elevated cellular uptake.

### Results

Using native BLG and two CBLGs bearing different cationic groups in the form of either molecules or nanoparticles, the research demonstrated how the chemical composition influenced the surface charge, hydrophobicity, and particle size of biopolymer-based drug carriers. The research revealed the complexity of the transport and delivery of oral-administrated drugs, in that a specific property (e.g., small size) might benefit the performance of the drug carrier in some biological procedures while lower their efficacy in other processes. Results suggested that CBLGs absorbed on the negatively charged serum proteins in the cell culturing medium, which altered their properties and behavior of the former. This research not only provided an attractive drug delivery vehicle but also shed some light on the fate of nano-sized drug carriers with well-defined surface structure.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
704	Nutrition and Hunger in the Population
723	Hazards to Human Health and Safety

### V(H). Planned Program (External Factors)

#### External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (Urban sprawl and State Budgets)

#### Brief Explanation

### V(I). Planned Program (Evaluation Studies)

#### Evaluation Results

Annie's Proect participants leave the program with a high intent to write business and marketing plans, use computers, check credit reports, prepare financial statement, update estate plans, and positively increase community and family relations. Writing business and marketing plans was an action that participants wanted to do (97%) and 42% actually followed through. Checking credit reports, updating estate plans, and positively increasing family communications were the actions that the greatest majority of participants engaged in. A medium-term outcome of Annie's Project is to help ensure the economic viability of farming operations. Data obtained from the participants indicate that the program is

successful in this regard. When asked if Annie's Project has increased their profitability 43% responded that yes it has. A range of dollar increases were then available for selection. The average Annie's project participant since 2008 has increased farm profitability between \$2165.31 and \$3780.84 with the average participant increasing farm profitability by \$3,123.96

### **Key Items of Evaluation**

In 2014 two hundred individuals utilized the AGsploration curriculum in 26 states and territories. In Maryland ninety-two AGsploration lessons were taught to 6,192 program participants and 7 trainings were held to certify 168 new curriculum teachers. On pre/post tests of students all indicated gaining more knowledge in the topics covered on agriculture and one in four participants indicated wanting to pursue a degree or occupation in agriculture science. 82% of trained teachers on a followup survey indicated the program improved their ability to teach about agriculture. 55% reported an increase in their attitudes towards using agriculture to teach STEM. 36% indicated an improvement in their students' knowledge of agriculture and their ability to understand the benefits of agriculture. Therefore the AGsploration program has increased the knowledge and appreciation of agriculture in Maryland and created a network of trained individuals to more effectively continue the educational cycle.

In September of 2012, UME launched the Beginning Farmer Success project. The Maryland Collaborative for Beginning Farmer Success builds on existing Extension resources and partnerships with Future Harvest-CASA and Southern MD Agriculture Development Commission, regional nonprofits, agricultural organizations, and experienced farmers to provide beginning farmers with easily accessible tools and practical experience-based training on farm production, marketing, land management, business planning, and financial resources. A follow-up survey with these beginning farmers indicated that as a result of this project, participants increased business knowledge by 74% and crop knowledge by 88%. Participants were asked if they would take action as a result of the program. 82% plan to implement business actions and 92% plan to implement crop actions. Organic grain producers that receive on-going education from UME indicated that they plan to implement the following: 8.82% improved pest management practices, 35.29% improved fertility management, 30.88% improved crop production practices, 4.41% use of risk management methods, 2.94% regulatory information, and 17.65% a new product or practice. Producers have increased profitability by \$29.62 per acre on 553.45 acres per producer. The average producer increased farm profitably by \$16,393.