

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

**Program # 4**

**1. Name of the Planned Program**

Climate Change: Natural Resources and Environment

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
101	Appraisal of Soil Resources			7%	
102	Soil, Plant, Water, Nutrient Relationships			10%	
111	Conservation and Efficient Use of Water			7%	
112	Watershed Protection and Management			11%	
121	Management of Range Resources			6%	
123	Management and Sustainability of Forest Resources			9%	
133	Pollution Prevention and Mitigation			18%	
136	Conservation of Biological Diversity			20%	
211	Insects, Mites, and Other Arthropods Affecting Plants			3%	
212	Pathogens and Nematodes Affecting Plants			2%	
403	Waste Disposal, Recycling, and Reuse			7%	
	<b>Total</b>			100%	

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

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

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	9.5	0.0
Actual Paid Professional	0.0	0.0	3.3	0.0
Actual Volunteer	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
0	0	646629	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	423164	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

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

### 1. Brief description of the Activity

#### Research

Current research efforts conducted by faculty, staff, and students from the College of Agricultural Sciences University of Puerto Rico, Mayagüez Campus on this programmatic area are: (1) the development of pollution prevention and mitigation practices for soil and watershed protection and management, including the behavior and fate of pesticides and other pollutants (agricultural residues) in soil and water, and the use of biological indicators to assess watershed nutritional status; (2) the development of soil improvement and maintenance practices; (3) the development and promotion of sustainable agricultural practices; and (4) biological diversity research (particularly the effects of non-native species on biodiversity, on management approaches for conserving and restoring biodiversity, and on the impact of agricultural management practices on natural ecosystems). Significant achievements last year include: (1) calibration/validation of remotely sensed solar radiation, which forms the basis of evapotranspiration estimates for Puerto Rico--an important component of computerized programs for scheduling irrigation in the Island; (2) demonstration that application of mature compost enhanced physical, chemical and biological properties of four tropical soils; (3) initiation of a project geared towards establishing the framework for the development of biologically based guidelines for regulating nutrient over-enrichment in rivers of Puerto Rico; and (4) development of activities providing preliminary insights into the role of emerging or invasive insect pest species in Puerto Rico--for example, the presence of six previously unreported moth species was ascertained.

#### Outreach/Education

This research program has for many years played a distinctive and integral role in educational outreach activities sponsored by the College of Agricultural Sciences. Research initiatives and results were disseminated last year through: (1) publication of research results in bulletins, newspaper articles, and popular magazines for farmers, and in refereed journals for scientists; (2) development of educational materials for stakeholders interested in the management and preservation of natural resources and agricultural sustainability; (3) seminars, farm/field day visits, workshops, conferences, websites, and exhibitions. Program participants remained committed to the search for more appropriate methods to reach our target audiences, and to the development of strategies and programs to increase community involvement.

### 2. Brief description of the target audience

Extension specialists and professionals, graduate and undergraduate students, government partners, producers, consumers, environmental groups and community-based groups.

**3. How was eXtension used?**

eXtension was not used in this program

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

**1. Standard output measures**

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	0	0	0	0

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

**Patent Applications Submitted**

Year: 2012  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2012	Extension	Research	Total
<b>Actual</b>	0	11	0

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

**Output Target**

**Output #1**

**Output Measure**

- Oral or poster presentations in professional scientific society meetings resulting from program activities

<b>Year</b>	<b>Actual</b>
2012	47

**Output #2**

**Output Measure**

- Number of Peer Reviewed publications.

<b>Year</b>	<b>Actual</b>
2012	11

**Output #3**

**Output Measure**

- Number of trainings, research demonstration activities and meetings with stakeholders to discuss research results and priorities.

<b>Year</b>	<b>Actual</b>
2012	51

**Output #4**

**Output Measure**

- Number of graduate students completing a MS degree and submitting theses under research projects in this program

<b>Year</b>	<b>Actual</b>
2012	3

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

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

O. No.	OUTCOME NAME
1	Number of stakeholders gaining knowledge on natural resources enhancement, dry forest ecology and management, microirrigation scheduling, and other soil enhancement and water conservation practices
2	Number of farmers adopting microirrigation management practices
3	Number of persons adopting practices that prevent biodiversity threats and losses.
4	Number of farmers adopting methods to increase soil organic matter content
5	Number of farmers reporting increased water use efficiency in their farms
6	Number of farmers that adopted practices to improve water resources.
7	Number of watersheds for which Total Maximum Daily Load (TMDL) for nutrients have been developed.
8	Number of stakeholders gaining knowledge on organic agricultural practices.
9	Number of persons gaining knowledge effects of non-native species on biodiversity.
10	Number of stakeholders gaining knowledge on pollution prevention and mitigation practices for soil and watershed protection and management
11	Number of persons adopting practices for watershed protection
12	Number of stakeholders gaining knowledge of efficient water use and water conservation practices
13	Number of stakeholders gaining knowledge on managing approaches for conserving and restoring biodiversity and on the impact of agricultural management practices on natural ecosystems
14	Number of stakeholders gaining knowledge on invasive species management practices
15	Number of persons gaining knowledge on biodiversity threats and losses, and on prevention practices

### **Outcome #1**

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

Number of stakeholders gaining knowledge on natural resources enhancement, dry forest ecology and management, microirrigation scheduling, and other soil enhancement and water conservation practices

Not Reporting on this Outcome Measure

### **Outcome #2**

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

Number of farmers adopting microirrigation management practices

Not Reporting on this Outcome Measure

### **Outcome #3**

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

Number of persons adopting practices that prevent biodiversity threats and losses.

Not Reporting on this Outcome Measure

### **Outcome #4**

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

Number of farmers adopting methods to increase soil organic matter content

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

- 1862 Research

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

Change in Action Outcome Measure

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

<b>Year</b>	<b>Actual</b>
2012	3000

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

**Issue (Who cares and Why)**

The need for better methods for agricultural waste disposal and management as an opportunity to increase soil organic matter content.

**What has been done**

Several multidisciplinary research studies have been performed in order to develop better waste disposal and increase soil organic matter content.

**Results**

Agricultural waste disposal and recycling practices have been developed for crops such as coffee and for dairy farms. More than 1,000 tons of coffee pulp have been composted and distributed for its use. Research results have been successfully disseminated mainly through web sites and blogs. Compost procedure and management videos have been posted at the website holding more than 2,000 members.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
403	Waste Disposal, Recycling, and Reuse

**Outcome #5**

**1. Outcome Measures**

Number of farmers reporting increased water use efficiency in their farms

Not Reporting on this Outcome Measure

**Outcome #6**

**1. Outcome Measures**

Number of farmers that adopted practices to improve water resources.

Not Reporting on this Outcome Measure

**Outcome #7**

**1. Outcome Measures**

Number of watersheds for which Total Maximum Daily Load (TMDL) for nutrients have been developed.

Not Reporting on this Outcome Measure

**Outcome #8**

**1. Outcome Measures**

Number of stakeholders gaining knowledge on organic agricultural practices.

Not Reporting on this Outcome Measure

**Outcome #9**

**1. Outcome Measures**

Number of persons gaining knowledge effects of non-native species on biodiversity.

Not Reporting on this Outcome Measure

**Outcome #10**

**1. Outcome Measures**

Number of stakeholders gaining knowledge on pollution prevention and mitigation practices for soil and watershed protection and management

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2012	305

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

**Issue (Who cares and Why)**

USEPA mandate to develop quantitative thresholds of impairment of nutrient for watershed and reservoirs. The target audiences of this project are the local regulatory agencies in charge of water quality protection such as the Environmental Quality Board and the Department of Natural and Environmental Resources.

**What has been done**

In order to define a biological index for nutrient impairment conditions in rivers and streams of Puerto Rico a research project was developed to assess the use of benthic algae as a biological

indicator of nutrient over-enrichment watersheds.

### **Results**

The assessment of biological indicators of stressor conditions is a key component for the development and implementation of regulatory thresholds or standards for the control of impairment of nutrients conditions in rivers and streams of Puerto Rico. Seven seminars and two workshops were presented to different audiences (e.g., scientists, students, farmers and personnel of regulatory agencies); the mean number of attendance was 34.

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

<b>KA Code</b>	<b>Knowledge Area</b>
101	Appraisal of Soil Resources
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

### **Outcome #11**

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

Number of persons adopting practices for watershed protection

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

- 1862 Research

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

Change in Action Outcome Measure

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

<b>Year</b>	<b>Actual</b>
2012	0

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

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

USEPA mandate to develop quantitative thresholds of impairment of nutrient for watershed and reservoirs. The target audiences of this project are the local regulatory agencies in charge of water quality protection such as the Environmental Quality Board and the Department of Natural and Environmental Resources.

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

Trainings, workshops and research demonstrations have been performed, all of which have reached a wide variety of audiences. The expectation is that attendees will be adopting the conservationist practices learned.

### Results

The determination of the current nutrient status of rivers in Puerto Rico is a key element to develop water quality guidelines for the establishment of sound pollution prevention and management practices for watershed protection.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

#### Outcome #12

##### 1. Outcome Measures

Number of stakeholders gaining knowledge of efficient water use and water conservation practices

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2012	25000

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

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

To remain competitive, farmers need to reduce production costs and increase the output of their farms. The adoption of microirrigation systems by farmers in the south coast of Puerto Rico, where drip irrigation is already popular, can contribute to these goals.

###### What has been done

Research to determine the irrigation schedule most suitable for the crop needs on the south coast area.

###### Results

A simplified scheduling technique for Puerto Rico, based on remote sensing data, has been made available at the website: <http://pragwater.com/2012/03/29/simple-irrigation-scheduling-tool-for-puerto-rico/>. Since its establishment the website has been visited by more than 25,000 users around the world and currently holds approximately 400 followers. Training on sound water management practices has been given to students, farmers and personnel of the regulatory agencies. Research results have been successfully disseminated mainly through web sites and

blogs.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water

#### Outcome #13

##### 1. Outcome Measures

Number of stakeholders gaining knowledge on managing approaches for conserving and restoring biodiversity and on the impact of agricultural management practices on natural ecosystems

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2012	1000

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

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

The need for better management approaches for conserving and restoring biodiversity, and the impact of agricultural management practices on natural ecosystems.

###### What has been done

Several multidisciplinary research studies have been performed in order to assess the impact of agricultural management practices on natural ecosystems. Mitigation practices to enforce conserving and restoring biodiversity have been developed.

###### Results

Research results have been successfully disseminated mainly through web sites, blogs, seminars, workshops and fact sheets. Trainings, workshops and research demonstrations have been performed, all of which have reached a wide variety of audiences. The expectation is that attendees have been adopting the conservationist practices learned.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity

- 211 Insects, Mites, and Other Arthropods Affecting Plants
- 212 Pathogens and Nematodes Affecting Plants

#### **Outcome #14**

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

Number of stakeholders gaining knowledge on invasive species management practices

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

- 1862 Research

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

Change in Knowledge Outcome Measure

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

<b>Year</b>	<b>Actual</b>
2012	300

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

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

The impact of native or non-native invasive species poses a serious challenge that requires a decision-making framework based on the prioritization of species for their control, as well as regulatory and public education programs.

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

Several multidisciplinary research studies have been performed in order to assess the impact of invasive species on agricultural and natural ecosystems. Invasive species management practices and methods have been evaluated.

###### **Results**

Research results have been successfully disseminated mainly through web sites, blogs, seminars, workshops and fact sheets. Trainings, workshops and research demonstration have been performed, all of which have reached a wide variety of audiences. The expectation is that attendees have been gaining knowledge about the impact and management of the invasive species.

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

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
211	Insects, Mites, and Other Arthropods Affecting Plants

**Outcome #15**

**1. Outcome Measures**

Number of persons gaining knowledge on biodiversity threats and losses, and on prevention practices

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2012	1000

**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>
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

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

**External factors which affected outcomes**

- Economy
- Appropriations changes

**Brief Explanation**

Budget reductions at the university and increases in the cost of higher education for students, may affect the number of scientists and graduate students working under this program.

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

##### **Evaluation Results**

No evaluation results are yet available. We will be implementing part of our evaluation plan this year, as described in last year's Plan of Work update.

##### **Key Items of Evaluation**