2008 University of Puerto Rico Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

The University of Puerto Rico Agricultural Experiment Station (AES) mission within the College of Agricultural Sciences (CAS) is to conduct scientific research that promotes an economically viable agricultural sector, the conservation and enhancement of natural resources and the environment, and a better quality of life in rural and urban areas. Our research also supports the industries that process agricultural raw materials and provides the technological base required for solving the problems affecting farmers, public and private institutions, and for rural development. The AES coordinates its academic activities with the teaching and extension faculty of the CAS, and incorporates into its research program faculty of these other two institutional branches. Although for this Plan of Work (POW) cycle, the AES and the Puerto Rico Agricultural Extension Service have opted to continue with separate submissions, all of our planned programs incorporate the collaboration of Extension faculty in the activities proposed to disseminate results, and many also extend this collaboration to other key aspects of the research process.

The AES has administrative offices and carries out research activities at two main centers: Río Piedras, in the northern San Juan metropolitan area, and Mayagüez, on the west coast of the island, where the CAS Campus is located. In addition, the AES has six substations comprising more than 2,000 acres of land distributed in the different geographical and ecological zones of Puerto Rico. This wide distribution allows for the evaluation of crop and animal production systems adapted to the conditions of different ecological zones. In addition, to advance regional goals, the AES participates in both multistate research and Special Grants from USDA□CSREES that target agriculture in the Caribbean Basin of the United States.

Until the present POW, research efforts in the AES were organized along traditional commodity lines. Commodity groups are still active and constitute an important link with our stakeholders, but they are no longer the basic unit structuring our research program. Adopting federal guidelines, we began in 2006 a transition towards defining and organizing research programs following the LOGIC model. During the initial years of our POW, programs were conceptualized around the situation and priorities of the area, but taking into account mostly the inputs and outputs from our Hatch and McIntire Stennis projects. This is the reason why some of the planned and actual outputs reported in 2007 appeared to be low. FY 2008 is the initial year in which we are incorporating into our annual report the outputs and FTE's contributed by most of our research projects. As a result, some programs show significant increases in these indicators since 2007. By 2010 all of our projects should be already incorporated into our POW and contributing towards achieving the outcomes of the planned programs, including those of new programs created to accommodate all of our research lines.

Core funding for the Agricultural Experiment Station's research program is provided by various sources. State funds are primarily used to cover salaries of academic and support personnel. USDA funding is crucial for directly financing the research program and supplementing salaries of faculty and staff. Formula-funds include Hatch Regular, Hatch Regional, McIntire-Stennis and Animal Health, although we have not had an active Animal Health project since 2005. Special Grants such as the Tropical and Subtropical Agriculture Research (T-STAR Caribbean) support targeted areas of research important for Puerto Rico, Florida and the Virgin Islands. This program was temporarily suspended by Congress during 2007, but was again enacted in 2008. Along with federal and state funding, there are extramural research grants and contracts such as those with the Natural Resources Conservation Service, Environmental Protection Agency, USDA-ARS, Puerto Rico's Department of Agriculture, Puerto Rico's Department of Natural Resources and other agreements with US-Universities. For FY2008 the Hatch allocation for Puerto Rico was $3,979,316. McIntire funds contributed an additional $101,051. We also had $699,420 as carryover funds from last year.

Planned Programs Overview

The Agricultural Economics, Marketing, Value Added and Community Development Program is the smallest of our research programs, although its contribution to the analysis of the conditions affecting agriculture and rural areas is increasingly recognized as vital to the search for alternatives for local commodities and communities. The total FTE/SY dedicated to this program in 2008 was 2.1. During this year studies to explore consumers' preferences for roots and tubers and costs of production of poinsettias, one of our principal ornamental crops, were continued. Also, a survey of meat managers of the principal supermarket chains in the island was conducted, to determine preferences for different types of meats. Results are being analyzed and will be presented in commodity meetings with producers and other stakeholders.

Rising imported food prices during the year attracted increased public attention to Puerto Rico's fragile food security, and to the need to urgently adopt measures to protect agricultural resources and augment the output of the farm economy. In collaboration with Extension Faculty, researchers participated in meetings with environmental and labor organizations with an interest in land use policy and food security issues, and offered recommendations to farmers and community organizers on strategies to manage ongoing or potential change. The major limitation faced by this program at present continues to be the lack of faculty members with the expertise needed to conduct research in the program's associated disciplines. A new rural sociologist recruited in 2006 left the university by the end of last year and one of our agricultural economists took a study-leave to finish her PhD.

The Food Science, Safety and Technology Program (FSST) is a new addition to our research programs whose ultimate goal is to conduct research and development activities to improve production processes of value-added agricultural products. The program seeks to generate new business opportunities, or process and product improvements that could potentially enhance the competitiveness of current food-based industries. Being still in its development stage, faculty efforts this year were largely devoted to the final set-up of the recently-built facilities for the program, and to the search of external funding to address the research needs identified by AES stakeholders. The program is also actively pursuing industry collaborations, and provided important services to industries, such as microbiological, chemical and nutritional analysis of given products' samples.

During 2008, the AES allocated 11 SYs to address the Integrated Management of New and Emerging Pests (IMNEP) program’s goals. One of these goals is to establish Pest Management Strategic Plans (PMSP) for major commodities to assist with defining priorities for the program. The development of these PMSPs is still very challenging. However, significant advances are already in place with research conducted in the vegetable production southwest area for tomato. Research results have been complemented with outreach activities directed to the tomato industry, including small scale producers. This crop already experienced a production increase of 215 Tons from the previous year.

Research directed to the reduction of high risk pesticides is promising. Citrus leaf miner and the Asian citrus butterfly can be decreased with *Bacillus thuringiensis* subs. *kurstaki,* and spinosad. Integrated approaches to control avocado root rot have demonstrated that the use of vegetative cover crops improved soil physical properties, promoting root health and development.

We have also continued with active participation within the Southern Plant Diagnostic Network (SPDN). Advances in the use of DNA-based diagnostics for pathogens are providing an accurate characterization of fungal pathogens. Laboratory diagnostics for regulatory pathogens for soybean, corn, cotton, rice, sorghum and sunflower were implemented at the Disease Clinic. These activities have had a subsequent positive impact on the seed industry in Puerto Rico. The need for a correct identification of biotic and abiotic diseases is now well understood by both producers and by the seed industry. Participating researchers believe that these stakeholders' acknowledgement of the need to correctly identify the disease or pest before a spray decision is made, has been the single most important impact of our program in the island. Nevertheless, we are still lacking resources to incorporate an evaluation component to these efforts that could provide numeric data on these outcomes.

The Milk and Meat Production Systems program has the primary purpose of supporting the commercial livestock industries of the island, of which the production of bovine milk, and broiler and bovine meat are the leaders. We are also trying to incorporate into our program the research needs of other livestock commodities, such as those of pork, goats and sheep farmers, recognizing the significance that these small animals have for the viability of many small farming operations. According to the 2007 Census of Agriculture of Puerto Rico, livestock and related products generate more agricultural income than crops in the local economy and these industries must be modernized, diversified and well managed if they are to spearhead a rebound of the agricultural sector, which experienced an 11% income decline since 2002. During 2008 the AES allocated 11.8 FTE/SY and more than half of our Hatch funds to this program. Research has continued on the development of new forage resources and better management of those already under extensive use, in an effort to substitute for part of the concentrates upon which milk production in Puerto Rico heavily depends. Studies on forage dependent feeding practices, animal management, animal genotypes, and carcass and meat characteristics are also underway. The latter will be used to devise a local system of beef grading. A major effort in progress is also aimed at educating the consuming public as to the health benefits of locally produced grass-fed beef. Research efforts with small ruminants are closely associated with those of forages and include studies on the voluntary consumption and digestibility of novel forage resources; non-pharmaceutical-dependent methods of controlling internal parasites, such as use of shrubs with high levels of condensed tannins; haylage and silage production and evaluation; and use of underground, trickle irrigation for efficient water utilization in forage production.

The outreach activities carried out during the year were generally successful in furthering contacts and interchanging information with producers, however, no systematic means of determining the impact that those activities had at the producers’ farm were in place and so far few quantitative data of this sort are available. The attempts to achieve a closer collaboration between the Agricultural Experiment Station and the Agricultural Extension Service that began at the administrators level during the year, constituted a first step toward a cooperative effort that is essential to obtain meaningful quantitative evaluations as to

the outcomes achieved under this and other program areas. One encouraging possible impact noted was the number of dairy and especially small ruminant producers who have obtained propagating materials from the Experiment Station to establish recommended varieties of forage at their farms. And while the area of milk production research was affected by delays in the construction of new facilities, with the new milking parlor soon scheduled to become fully operational, we expect to be able to greatly improve the future impact of this program.

One of the principal goals of the Natural Resources and Environment Research Program is to develop, perform and support scientific research on the impact of agricultural practices in the environment and natural resources. In 2008 the AES allocated 11.5 FTE/SY to projects in this program, about have of them financed by non-formula funds. Water quality research continued with work already begun on the characterization of the chemical and biological status of the most important watersheds of Puerto Rico. Studies on the impact of coffee processing activities on the nutritional status of river waters concluded that these activities did not exert any significant deteriorating impact on water quality. Following recommendations devised by researchers, extension and natural resources agencies, coffee producers had been adopting ecological processing technologies. These results could help coffee producers document their compliance with water quality standards when required to do so by regulatory agencies.

Evaluations of irrigation levels and frequencies for various crops, based on ET calculations performed under microirrigation research projects, confirmed that implementation of management practices that prevent stress during growth can increase production and commercial yield while reducing fertilizer losses. Research on the performance of cover anaerobic lagoons for energy, nutrient and carbon recycling continued with its experimental phase. Studies to quantify off-field nutrient losses in runoff from tropical agroecosystems and factors influencing their transport were also conducted. They complement other research activities aimed at determining the best management practices for dairy manure management. Soil erosion and nutrient transport research continued with studies on the following topics: soil management practices to minimize problems of poorly drained upland soils, evaluation of micronutrient behavior in highly weathered soils, and the evaluation of synthetic materials and ground cover germplasm for erosion control.

Research on biodiversity and conservation, and threats to agriculture and natural ecosystems was also carried out during last year. Studies in progress include a project to protect native and endangered cacti in Puerto Rican dry forests from a new invasive mealybug. Findings from dry forest research on species regeneration after hurricanes show that the multi-stemmed growth habit of dry forest trees can be generated naturally by hurricanes without breaking stems. This increases the value of forest stands in the perception of managers and the public because these lands are no longer assumed to be degraded. These findings are changing the understanding of scientists, forest managers, citizens, and government officials about the natural regeneration methods of the tropical dry forest.

The Plant Genetic Resources, Breeding and Production Systems Program has kept its relevance as an essential component of the AES research program. In FY2008 it engaged 18.3 FTE/SY and received about a quarter of our Hatch funds. Judged against previous years' outputs, notable progress was made in hosting activities for stakeholders at the stations facilities and in other experimental fields. On-farm research to validate technologies also increased during last year.

In addition, work continued on the selection and purification of germplasm of traditional crops, on the development of improved cultivars, and on the distribution of germplasm to farmers, scientists and to the public. After final evaluations, a tropical-type sweet potato genotype was selected for release under the cultivar name ‘Pujols’. This cultivar combines high yield stability with the flesh attributes demanded by the local market. Evaluations needed for the release of two tropical pumpkin cultivars, ‘Verde Luz’ and ‘Taína Dorada’, were also completed. During this past year, seeds of improved varieties of bean, pumpkin, pigeon pea, corn, eggplant and black eye pea were sold at the field stations, thus indicating in our view, farmers’ continued support and acceptance of the outputs of this research program. Propagation material offered and purchased by farmers also included improved varieties of sweet potato and tanier.

More than twenty five presentations were delivered at scientific meetings by program researchers. Ten articles were published in refereed journals and eleven non-refereed pieces were included in various proceedings. More than 1900 technological packages of the different crops were distributed during the year. A web site for the vegetable breeding program -with special emphasis on tropical pumpkin- and a Blog for turf management were also developed. Electronic pages dealing with research activities under this program received over 1500 hits.

On the downside, a significant increase in the cost of fertilizers resulted in decreased use of this input and has become an important economic constraint for farming operations. The fruit commodity group held a meeting with the participation of 14 stakeholders to discuss alternatives to reduce the cost of fertilization and research needs in this area. A competitive Hatch-funded call for proposals was made to support research projects dealing with fertilization issues from a multidisciplinary perspective. Research continued on the use of organic fertilization in plantains, a major crop in Puerto Rico, as an alternative to traditional fertilizers. Research was initiated on the proper fertilization management for vegetables production under hydroponics systems.

Total Actual Amount of professional FTEs/SYs for this State

Year:2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	47.6	0.0
Actual	0.0	0.0	56.9	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Internal University Panel
- Expert Peer Review

2. Brief Explanation

There has been no significant change in our Program Review Process since last year update was submitted. In 2005, however, we changed the way in which our Hatch□funded research proposals are initially granted. In response to internal and external evaluations requesting that a portion of Hatch funds be allocated to projects on the basis of an annual call for proposals with the year's revised priorities, part of our formula□funded research is now competitively granted within CAS on the basis of said proposals. More specifically, the scientific peer review process of Hatch proposals is the following:
An annual call for proposals which includes the year's revised research priorities is prepared and distributed by the AES Research Office. Proposals are submitted to the Assistant Dean for Research with the preliminary endorsement of the respective Department Head. The Assistant Dean for Research sends the proposal again to the corresponding department head, to a local peer reviewer and to an external reviewer for their written comments on the scientific merit of the proposed research and compliance with the AES strategic plan. Proposals and their reviewers' input are discussed and evaluated by the CAS Associate and Assistant Deans for Research, and a final decision is taken by the administration. Project directors of the selected proposals are given the opportunity to incorporate reviewers' suggestions and make adjustments as appropriate. These proposals are then sent to the USDA-CSREES Office of the Administrator, where the respective national program leaders review them. Once the proposals are approved in Washington, the new or revised projects are included in the AES research program.This year, following this process, several new proposals were granted covering the research priorities of our programs in the areas of ruminant nutrition, organic fertilization, molecular and morphological characterization of serious virus vectors and watershed quality. The incorporation of external reviewers in the merit assessment of proposals is certainly an asset, but it is increasingly difficult to recruit reviewers probably due to the increase in the number of competitive calls for proposals being implemented in the federal and local system.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals

Brief Explanation

Two types of meetings are held in Puerto Rico to identify critical issues that should be addressed by AES research programs. Stakeholder input is also considered during the establishment of research priorities. First, the AES continues to celebrate an annual meeting with researchers, extension faculty, farmers and other members of the public interested in the work performed by the different programs or commodity groups. In these meetings the progress of active research projects is discussed, preliminary results are shared and further input is sought from participants to update research needs and priorities. The meeting is usually celebrated in the Research Center or Substation closest to the principal area of production, and coordinated with the Agricultural Extension Service commodity specialist and agricultural agents of the region. Both the commodity leader and the extension personnel identify and invite members of producers associations, individual farmers, faculty and students, government officials, and community organizations with an interest in the commodity's work and related research programs. Meeting information is also posted in the AES website and is frequently printed in the local agricultural monthly journal. The Associate Dean sends personal invitations to relevant government officials and positional leaders of stakeholders groups. The input received in these meetings from all the stakeholders present is summarized, evaluated and presented in a meeting of commodity group leaders, program coordinators and research administrators, where final decisions are made concerning research priorities. The list of priorities assembled through this process guides the year's call for proposals for new Hatch and Special projects.

Second, commodity group leaders, program coordinators and directors of integrated academic departments have organized thematic workshops, seminars, and field days where research results have been shared and alternative views on the subject --including further research and extension needs, or public policy determinations-- have been discussed. The feedback received in these activities continues to inform the current process of program assessment for our rolling five-year POW.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Other (consultations with local extension agents and commodity leaders)

Brief Explanation

Stakeholders were identified through commodity leaders, extension personnel and through local advisory committees established by administrators of the CAS.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals

Brief Explanation

Input from stakeholders is collected at the meetings convened by commodity group and program leaders. Stakeholders are asked to fill a written evaluation at the end of the meeting which includes questions about the most critical issues affecting their commodities and localities and about our research priorities. This information is summarized in a report made by the commodity and program leaders.

3. A statement of how the input was considered

- To Identify Emerging Issues
- Redirect Research Programs
- In the Staff Hiring Process
- To Set Priorities

Brief Explanation

Stakeholders input have been used in the determination of the research priorities of each planned program and commodity area, and these, in turn, have guided the Request for Proposals emitted by the AES Research Office during the year. The input received during the past three years from both traditional and non-traditional stakeholders have been critical for starting new pilot experimental projects in organic agriculture and in compost production, linked to our Natural Resources and Environment program and to the coffee and ornamental commodity groups. More recently, it helped define research priorities in the area of crop fertilization.

Brief Explanation of what you learned from your Stakeholders

-The list of problems identified by our stakeholders as plaguing their operations is very long, but on closer analysis reveals that in many instances there are already technological alternatives available that have been researched and could improve their situation, if they could be more actively disseminated among Extension personnel and farmers. This closer integration between research and extension needs to be coordinated at higher administrative levels. This year, initial steps were taken by administrators in this direction, and a closer collaborative relationship is being established between research and extension faculty working in our Integrated Management of New and Emerging Pests program and Extension's Crop Protection program. We hope other programs will follow upon this lead in the future.

-Participants in stakeholders' meetings would like to see a stronger participation in these activities from all components of the agrofood system: farmers, processors, distributors and government officials in charge of the agricultural sector. Many farmers expressed their willingness to partner in research projects and were supportive of on-farm collaborations.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	3979316	0

2. Totaled Actual dollars from Planned Programs Inputs

	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	4487345	0
Actual Matching	0	0	5283468	0
Actual All Other	0	0	873600	0
Total Actual Expended	0	0	10644413	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous years

Carryover	0	0	699420	0

V. Planned Program Table of Content

S. NO.	PROGRAM NAME
1	Milk and Meat Production Systems Resources
2	Integrated Management of New and Emerging Pests
3	Plant genetic resources, breeding and production systems
4	Natural Resources and Environment
5	Agricultural Economics, Marketing, Value Added and Community Development
6	Food Science, Safety and Technology Program

Program #1

V(A). Planned Program (Summary)

1. Name of the Planned Program

Milk and Meat Production Systems Resources

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
202	Plant Genetic Resources			18%	
204	Plant Product Quality and Utility (Preharvest)			5%	
205	Plant Management Systems			8%	
213	Weeds Affecting Plants			5%	
302	Nutrient Utilization in Animals			30%	
307	Animal Production Management Systems			12%	
308	Improved Animal Products (Before Harvest)			10%	
313	Internal Parasites in Animals			5%	
405	Drainage and Irrigation Systems and Facilities			7%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	11.0	0.0
Actual	0.0	0.0	11.8	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	2358569	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1906383	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	471801	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research has continued on the development of new forage resources and better management of those already under extensive use, in an effort to substitute for part of the concentrates upon which milk production in Puerto Rico heavily depends. Studies on forage dependent feeding practices, animal management, animal genotypes, and carcass and meat characteristics are also underway. The latter will be used to devise a local system of beef grading. A major effort in progress is also aimed at educating the consuming public as to the health benefits of locally produced grass-fed beef. Research efforts with small ruminants are closely associated with those of forages and include studies on the voluntary consumption and digestibility of novel forage resources; non-pharmaceutical-dependent methods of controlling internal parasites, such as use of shrubs with high levels of condensed tannins; haylage and silage production and evaluation; and use of underground, trickle irrigation for efficient water utilization in forage production.

The areas of research most active during the year 2008 under this Program Area were the following: (1) grass-fed beef cattle production, (2) factors affecting quality characteristics of local beef, (3) performance of slick-hair dairy cows, (4) utilization of organic wastes from dairy farms as fertilizer, (5) agronomic and nutritional evaluation of novel grass, legume and shrub forages for feeding small ruminants, (6) control of interval parasites in small ruminants using forages high in condensed tannin content, (7) testing of forages and management practices leading to production of high quality hay and haylage, (8) evaluation of different grasses for characteristics that affect ensiling and use of silage addives, (9) subterranean irrigation of forages. The preliminary or final results of a number of these research endeavors were communicated to stakeholders at diverse outreach activities.

The outreach activities carried out during the year included: one meeting with producers specifically to receive their inputs as to research priorities, six consultation sessions with government officials, eight seminars, fora or lectures, eight training sessions for producers, seven training sessions for Agricultural Extension Service agents and ARS professionals, and six field days.

2. Brief description of the target audience

Dairy farmers, beef cattle producers, poultry producers, commercial hay producers, extension professionals, government personnel, scientists, and private professionals.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	0	0	0	0
2008	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	4	
2008	0	6	6

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of meetings held with stakeholders to discuss the industries' situation and research priorities

Year	Target	Actual
2008	4	4

Output #2

Output Measure

- Number of popular (non-refereed) publications prepared based on research results.

Year	Target	Actual
2008	3	2

Output #3

Output Measure

- Number of field days held in research facilities and/or private farms to demonstrate RMPs based on research results.

Year	Target	Actual
2008	4	6

Output #4

Output Measure

- Number of publications made in refereed scientific journals.

Year	Target	Actual
2008	4	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Number of participants in field days willing to adopt the RMPs demonstrated.
2	% market participation of local beef.

Outcome #1

1. Outcome Measures

Number of participants in field days willing to adopt the RMPs demonstrated.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	25	30

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The on farm production, processing, distribution, wholesale and retail trade and consumption of products obtained from livestock make a large contribution to both the formal and informal economies of Puerto Rico, while creating thousands of employments both, direct and indirect, and propelling a very substantial monetary circulation. At present, local productions and marketing of fresh milk do not face direct competition from imported milk, and imports of rabbit meat are not permitted for reasons of animal hygiene. Aside from these two cases, all other local livestock products compete against products imported from lands where production costs are lower. Under such conditions it is imperative that producers strive for optimal efficiency in their operations and to obtain high-quality meats and milk, by adopting RMPÃ‚Â's.

What has been done

Research has continued on the development of new forage resources and better management of those already under extensive use, in an effort to substitute for part of the concentrates upon which milk production in Puerto Rico heavily depends. Studies on forage dependent feeding practices, animal management, animal genotypes, and carcass and meat characteristics are also underway. The latter will be used to devise a local system of beef grading. Research efforts with small ruminants are closely associated with those of forages and include studies on the voluntary consumption and digestibility of novel forage resources; non-pharmaceutical-dependent methods of controlling internal parasites, such as use of shrubs with high levels of condensed tannins; haylage and silage production and evaluation; and use of underground, trickle irrigation for efficient water utilization in forage production.

Results

Unfortunately the number of participants in field days and training sessions willing to adopt RMP demonstrated was not adequately measured and recorded. Emphasis will be placed on obtaining this information at future activities of this nature. However, it can be said that the present crisis situation is reflected in greater interest on the part of many producers to try new practices on their farms, which they might not be likely to do if habitual practices were sufficient to ensure a reasonable economic return.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
308	Improved Animal Products (Before Harvest)
202	Plant Genetic Resources
205	Plant Management Systems
307	Animal Production Management Systems
313	Internal Parasites in Animals

Outcome #2

1. Outcome Measures

% market participation of local beef.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	14	16

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
308	Improved Animal Products (Before Harvest)
302	Nutrient Utilization in Animals
307	Animal Production Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Competing Programmatic Challenges
- Other (Delays in new facilities construction; deterioration of research facilities and equipment)

Brief Explanation

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V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- Other (Small sample survey)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

Program #2

V(A). Planned Program (Summary)

1. Name of the Planned Program

Integrated Management of New and Emerging Pests

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
211	Insects, Mites, and Other Arthropods Affecting Plants			34%	
212	Pathogens and Nematodes Affecting Plants			40%	
213	Weeds Affecting Plants			2%	
215	Biological Control of Pests Affecting Plants			4%	
216	Integrated Pest Management Systems			20%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	14.4	0.0
Actual	0.0	0.0	11.0	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	861332	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1051065	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	103851	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

PRAES is addressing priorities established in targeted crops identified as a result of stake holders' involvement in commodity group meetings. The program priorities are 1) fast and accurate pest and disease identification and diagnosis; (2) development of Pest Management Strategic Plans (PMSPs); (3) increased testing of reduced risk pesticides; and (4) integrated pest management research and extension activities. The development of PMSPs is still a challenge. However, significant advances are already in place with research conducted in the vegetable production southwest area for tomato. This crop has already experienced a production increase of 215 Tons over that of the previous year. The results of this study will be complemented with outreach activities directed to the tomato industry, including small scale producers. Research directed to the reduction of high risk pesticides is promising. Damage by citrus leaf miner and the Asian citrus butterfly can be decreased with *Bacillus thuringiensis* subs. *kurstaki,* and with spinosad. Integrated approaches to control avocado root rot have demonstrated that the use of vegetative cover crops improved soil physical properties, thus promoting root health and development.

For new diseases such as black sigatoka the selection of resistant cultivars and the search for new products with different modes of action will ensure the design of a spray program which will increase the efficacy in the control of the pathogen and delay the development of fungicide resistance. Advances in the use of DNA-based diagnostics for pathogens, as part of the Southern Plant Diagnostic Network, is providing an accurate characterization of fungal pathogens. Laboratory diagnostics for regulatory pathogens for soybean, corn, cotton, rice, sorghum and sunflower were implemented at the Disease Clinic. The impact of this activity has a subsequent positive impact on the seed industry in Puerto Rico. Also the implementation of the Caribbean Regional Diagnostic Network, involving Costa Rica, Jamaica, Haiti, Belize, The Dominican Republic and Puerto Rico, was an important achievement. PRAES seeks to advance the adoption of IPM practices by improving the collaboration with the Extension Service.

2. Brief description of the target audience

- Extension Specialists and Agents;
- Academic Programs Faculty and Students
- Seed Companies
- Producers and Commodity Groups
- Consumers; and
- Federal and State Agricultural Agencies (PRDA, USDA/APHIS, USDA/ARS, USDA/NRCS).

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	0	0	0	0
2008	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	3	
2008	0	8	8

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of 'Pest Management Strategic Plans' (PMSPs) developed

Year	Target	Actual
2008	1	1

Output #2

Output Measure

- Number of peer-reviewed articles in major scientific journals resulting from program activities.

Year	Target	Actual
2008	3	3

Output #3

Output Measure

- Peer reviewed articles in local Scientific Journals resulting from program activities.

Year	Target	Actual
2008	7	5

Output #4

Output Measure

- Abstracts or oral presentations in professional scientific society meetings resulting from program activities.

Year	Target	Actual
2008	9	14

Output #5

Output Measure

- Poster presentations in professional scientific society meetings resulting from program activities

Year	Target	Actual
2008	9	23

Output #6

Output Measure

- Number of joint Research-Extension activities that include pest diagnostics and identification, use of reduced impact pesticides, or research on pesticide impact assessment on non-target beneficial organisms.

Year	Target	Actual
2008	3	3

Output #7

Output Measure

- Number of program-sponsored scientific events, like symposia, topic conferences, and open houses

Year	Target	Actual
2008	4	4

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Number of stakeholders with increased knowledge on emerging pests and aware of non-target pesticide effects
2	Number of persons that adopted reduced risk pesticides and practices
3	Number of farmers reporting decreased losses due to key and emerging pests

Outcome #1

1. Outcome Measures

Number of stakeholders with increased knowledge on emerging pests and aware of non-target pesticide effects

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	80	80

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The producers who have participated in the field days and commodity meetings in the different Experiment Stations are still a very limited few. The perceived impact of the management practices presented is difficult to evaluate because of the scientific nature of the information released at these events. Often recommendations based on Integrated Pest and Disease Management research are not well adopted because of the producers' level of understanding.

What has been done

PRAES has focused on outreach activities oriented to several commodity groups. Producers need more on-farm research and activities based on their own challenges and problems. Frequent visits to farms confirm the use of several of the practices taught in meetings celebrated to discuss research results in pest and diseases of cucurbits, tomato and peppers. PRAES believes that it is important to demonstrate the economic and environmental impact of the different alternatives. Producers who have participated in the outreach activities have realized the importance of basic research for understanding the principles of Integrated Pest Management.

Results

Frequent contact with producers at the Plant Disease Clinic, located in the vegetable producing southwest area of Puerto Rico, has produced a record number of diseased samples for pathogen identification. The need for a correct identification of biotic and abiotic diseases is now well understood by producers as well as by the seed industry. Before a spray decision is made, the disease or pest has to be identified; this procedure has been the single most important impact of PRAES on the island. Preliminary studies on the introduction of Beauveria bassiana to control coffee berry borer are promising. The use of a commercial product with B. bassiana has been adopted by coffee growers. Another example that illustrates the impact of research is the management of watermelon vine decline by planting early maturity cultivars that are less affected by the disease; also there is the use of biological pesticides in the management of the vector population.

4. Associated Knowledge Areas

KA Code	Knowledge Area
213	Weeds Affecting Plants
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants

Outcome #2

1. Outcome Measures

Number of persons that adopted reduced risk pesticides and practices

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	25	25

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The PRAES new IPM program is focusing on developing science-based pest management plans that will lead to the increased utilization of ecologically-based integrated pest management. At present, the influence of chemical companies in pest and disease control recommendations is a factor that determines farmers' decisions to spray; therefore, a limitation in the adoption of new practices may occur.

What has been done

PRAES has supported the implementation of the Plant Diagnostic Clinic which is essential for the identification of major pests and diseases and thus the bases for detection of new and emergent diseases. Concerning the adoption of integrated pest and disease management strategies, meetings have been conducted with chemical companies and growers to educate them about spray decisions. Practices to manage important pests in vegetables such as Helicoverpa zea and Bemisia tabaci have been disseminated during these meetings. The use of reflective plastic and biological insecticides to decrease whitefly in watermelon has also been discussed.

Results

Disease and pest identification have resulted in seven new insects and pathogen identifications for Puerto Rico. Over 1,000 samples have been processed and identified for fungal, bacterial and viral diseases. A total of 420 serology tests have been conducted for virus and bacterial detection, and 138 different fungal pathogens of major crops have been sequenced and identified. Twenty six different sequences of new fungi identifications have been deposited in the GeneBank. This is a major achievement in the diagnostics of important crop diseases that will hopefully lead to better planning of management practices. Meetings for the dissemination of research results have gathered over 200 growers. In the southwest vegetable production area, approximately twenty-five of these growers have already included in their operations some of the disseminated practices for insect and disease control in tomatoes, peppers and cucurbits.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants

Outcome #3

1. Outcome Measures
Number of farmers reporting decreased losses due to key and emerging pests

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	25	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Growers are already experiencing fewer disease outbreaks in their crops because of adoption of practices observed on field days.

What has been done

Weekly visits to growers
Presentations at commodity meetings
Participation on producers' meetings
Annual field days
Distance diagnostics training
Responses to clients requests
IPM seminar for vegetable growers and chemical companies
Presentations at yearly meetings

Results

Improved fruit and vegetable quality and profitability, enhanced farm sustainability, evaluations with growers, and observations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
213	Weeds Affecting Plants
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Competing Programmatic Challenges
- Other (Need to improve transfer mechanisms and ways to measure adoption of practices)

Brief Explanation

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V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- During (during program)
- Other (Yearly baseline indicators)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

Program #3

V(A). Planned Program (Summary)

1. Name of the Planned Program

Plant genetic resources, breeding and production systems

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms			20%	
202	Plant Genetic Resources			20%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			25%	
204	Plant Product Quality and Utility (Preharvest)			5%	
205	Plant Management Systems			30%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	12.9	0.0
Actual	0.0	0.0	18.3	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	1020157	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	1652934	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	64031	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

1 Development and release of improved cultivars of crops of economic importance

-Taro genotypes with tolerance to the taro leaf blight were imported from the University of Hawaii.

-After final evaluations, a tropical-type sweet potato genotype has been selected for release under the cultivar name 'Pujols'.

-The evaluations needed for the release of two tropical pumpkin cultivars, 'Verde Luz' and 'Taina Dorada', were completed.

-Three new genotypes of Musa spp, identified as tolerant to the sigatoka disease, were imported and evaluation began on their adaptability to our production system and market demands.

2 Electronic publications of descriptions of germplasm collections

-A web site for the vegetable breeding program, with special emphasis on tropical pumpkin, and a Blog for turf management, were developed during the past fiscal year.

3. Distribution of germplasm to scientists and the public

- The AES seed program offered for sale seeds and setts of varieties adapted to local conditions of the following crops: bean, pigeon pea, field corn, sweet pepper, tropical pumpkin, sweet potato, tanier, banana, plantain, cassava and taro.

-The AES germplasm collections were used as sources of genetic material for local producers.

4. Publish technology packages describing best management practices for crops of economic importance.

-A CD on BMP for post harvest management of plantains and bananas was published in collaboration with the Agricultural Extension Service.

5. Hosting field days for stakeholders at different Substations in collaboration with the Agricultural Extension Service, and organize field days to seed production fields, germplasm collections and other experimental fields.

-The root and tubers commodity group held various field days in AES facilities and in private farms. In these field days BMP and newly developed varieties were showed for several crops including tanier, sweet potato and taro. The vegetable crops and fruits commodity groups also hosted field days during the year. In coordination with the Agricultural Extension Service, program personnel held a field demonstration and a workshop on pruning and management of fruits orchards.

6- Increased on-farm research to validate new technology

-On farm trials to validate the performance of legumes as cover crops for citrus orchards were continued, and others to validate the use of Bahiagrass for erosion control in avocado orchards were concluded.

-A 16 acre validation trial was established to evaluate the adaptation of new maize varieties for forage production.

-Advanced genetic lines of sweet potato were planted on farmers fields in the southern coastal valleys, to evaluate their performance under commercial settings.

7- Publication of research results in bulletins for farmers, and in refereed journals for scientists.

-Ten articles were published in refereed journals by the program's personnel.

8. Presentations of research results at scientific meetings

-Twenty seven presentations at scientific meetings were made by the program's personnel.

2. Brief description of the target audience

Targeted audience consists of farmers, government professionals, legislators, county agents, scientists, USDA professionals, and professionals from the private sector.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	0	0	0	0
2008	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	2	
2008	0	10	10

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of stakeholders to adopt the proposed BMPs.

Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Focus groups of collaborators' opinions of the new technologies being validated

Year	Target	Actual
2008	1	0

Output #3

Output Measure

- The number of "hits" on project-related web sites Records of the sale of hard copies of AES publications.

Year	Target	Actual
2008	1200	1500

Output #4

Output Measure

- Records of the number and type of germplasm accessions distributed to scientists and the public.

Year	Target	Actual
2008	220	200

Output #5

Output Measure

- Number of participants in the field days coordinated with Extension

Year	Target	Actual
2008	120	170

Output #6

Output Measure

- Number of students attending field days to seed production fields, germplasm collections and other experimental fields.

Year	Target	Actual
2008	120	120

Output #7

Output Measure

- Number of refereed publications

Year	Target	Actual
2008	2	10

Output #8

Output Measure

- Number of non-refereed publications

Year	Target	Actual
2008	1	11

Output #9

Output Measure

- Number of presentations in scientific meetings

Year	Target	Actual
2008	1	27

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Number of stakeholders to adopt the proposed BMPs
2	Records of the sales of seed of improved cultivars at the Substations.

Outcome #1

1. Outcome Measures

Number of stakeholders to adopt the proposed BMPs

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	110	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Puerto Rico's population has a high dependence on imported food. Local agricultural products compete against those imported from countries where production costs are lower. To maintain their competitiveness, local farmers have shown interest on mechanisms to improve the profitability of crop production and commodity marketing. Nevertheless, to achieve sustainable farming systems, profitable BMPs for crop production that protect natural resources must be devised. Last year's increases in the cost of fertilizers have had a significant negative impact over local production and present a challenge to both producers and researchers. Other stakeholders, such as government officials and legislators, recognize the need to improve the quantity and quality of local agricultural production and the complexity involved in reevaluating technological recommendations to tailor them to present conditions.

What has been done

Work has continued on the selection and purification of germplasm of traditional crops, on the development of improved cultivars, and on the distribution of germplasm to farmers, to scientists and to the general public. BMPs for local crops and farming systems are being reevaluated and alternatives are been sought for maintaining production levels and profitability. A CD on BMPs for the postharvest management of plantains and bananas was published in collaboration with the Agricultural Extension Service. Notable progress has been made on hosting activities for stakeholders at the stations' facilities and in other experimental fields. Also, on-farm research to validate newly developed technology increased during last year.

Results

The number of stakeholders, especially farmers, attending activities such as field days and workshops showed an increase over the previous year. Farm clients of this program are usually small-holders. While we still don't have a precise measure of technology adoption, since these activities are held to show the new technology developed under the program, we believe that the increase in attendance is an indicator of the willingness of producers to incorporate at least part of the demonstrated technologies into their farm operations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
204	Plant Product Quality and Utility (Preharvest)
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
202	Plant Genetic Resources

Outcome #2

1. Outcome Measures

Records of the sales of seed of improved cultivars at the Substations.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	110	110

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Farmers frequently point out that the lack of high quality seed and propagation material (setts) limits the production and acreage expansion of traditional crops. For example, shortage of plantain setts was evident last year. Farmers in Puerto Rico are typically smallholders, and commercial seed companies do not always maintain an inventory of the seeds or propagation materials used by these producers.

What has been done

The AES seed program offered for sale seeds and setts of varieties adapted to local conditions and management systems. For some crops, the AES is the only reliable source of seed. Seed from the following crops was sold during the year: bean, pigeon pea, field corn, sweet pepper and tropical pumpkin. Propagation material was available for sale for sweet potato, tanier, banana, plantain, cassava and taro. Also available was seed of quality-protein maize, for use in special projects or in particular situations. Citrus and mango germplasm collections were used to provide selected material for the commercial propagation of these fruits.

Results

The sale of seeds and setts of improved varieties remained strong during 2008. We believe this is an indicator of farmers continued support and adoption of the outputs of the AES research program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Programmatic Challenges
- Other (Increases in the price of fertilizers.)

Brief Explanation

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V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- During (during program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

Program #4

V(A). Planned Program (Summary)

1. Name of the Planned Program

Natural Resources and Environment

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			28%	
104	Protect Soil from Harmful Effects of Natural Elements			9%	
111	Conservation and Efficient Use of Water			5%	
112	Watershed Protection and Management			5%	
123	Management and Sustainability of Forest Resources			5%	
132	Weather and Climate			5%	
133	Pollution Prevention and Mitigation			38%	
136	Conservation of Biological Diversity			5%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	8.7	0.0
Actual	0.0	0.0	11.5	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	177706	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	566071	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	201770	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

A major goal of this research program is the development of sustainable practices for watershed protection and management. Water quality research has continued with work already begun on the characterization of the chemical and biological status of the most important watersheds of Puerto Rico. Another project aims to reduce the environmental impact of waste-water of coffee processing systems in watersheds. This study is producing baseline data that will enhance our understanding of the pollution generated by this agricultural activity, and is allowing researchers to formulate alternatives to address water quality problems related to the traditional and ecological coffee wet-processing. Research on the performance of cover anaerobic lagoons for energy, nutrient and carbon recycling continues on its experimental phase. Preliminary results suggest, however, that both incoming and lagoon biological oxygen demand are low for effective biogas production. Studies to quantify off-field nutrient losses in runoff from tropical agroecosystems, and factors influencing their transport, are also being conducted. They complement other research activities aimed at determining the best management practices for dairy manure management. Soil erosion and nutrient transport research continued with studies on the following topics: soil management practices to minimize problems of poorly drained upland soils, evaluation of micronutrient behavior in highly weathered soils, and the evaluation of synthetic materials and ground cover germplasm for erosion control.

Research on biodiversity and conservation, and threats to agriculture and natural ecosystems was also conducted during last year. Studies in progress include a project to protect native and endangered cacti in Puerto Rican dry forests from a new invasive mealybug. Another project is assessing the regeneration of native and introduced species in the dry forest in response to multiple disturbances (fires, hurricanes, dominance by exotic tree). The findings from this latter one are changing the understanding of other scientists, forest managers, citizens, and government officials about the natural regeneration methods of the tropical dry forest.

2. Brief description of the target audience

Extension Specialists and professionals, government partners, producers, consumers, and environmental groups.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	0	0	0	0
2008	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	4	
2008	0	8	8

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Target	Actual
2008	10	22

Output #2

Output Measure

- Number of Peer Reviewed publications.

Year	Target	Actual
2008	4	8

Output #3

Output Measure

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

Year	Target	Actual
2008	2	17

Output #4

Output Measure

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

Year	Target	Actual
2008	2	8

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 conservation 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 persons that adopted practices to improve water resources.
7	Number of watersheds for which a Total Maximum Daily Load (TMDL) for nutrients have been developed

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	60	81

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Water for farming is increasingly an island-wide issue as other sectors put forward competing demands for this resource. The issue is particularly acute in the south coast, where most of the large commercial fruit and vegetable operations are located. Farmers, extensionists, government officials and the general public need to have access to better information tools on water conservation and management.

What has been done

Calculation of evapotranspiration (ET) estimates for various crops.
Workshops and seminars on research results on the above topics and on microirrigation scheduling and maintenance, and on management of soils under microirrigation.
Publication of results in proceedings of professional associations and in refereed journals.

Results

Evaluations of irrigation levels and frequencies for various crops, based on ET calculations, confirm that implementation of management practices that prevent stress during growth can increase production and commercial yield while reducing fertilizer losses. However, under the arid conditions of southern Puerto Rico, better results were obtained by increasing the level and frequency of irrigation using the Pan Evaporation method.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
132	Weather and Climate

Outcome #2

1. Outcome Measures

Number of farmers adopting microirrigation management practices

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	10	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The adoption of technologies that can potentially improve water conservation and crop yield is particularly important in the arid south coast, where most of the large commercial fruit and vegetable operations are located. Irrigation is a resource with a high energy demand; maximization of crop water use efficiency is essential.

What has been done

Through workshops, seminars, and field days information has been provided on when and with how much water to irrigate, based on research results for different crops.

Results

Evaluations of irrigation levels and frequencies for various crops, based on ET calculations, confirm that implementation of management practices that prevent stress during growth can increase production and commercial yield while reducing fertilizer losses. However, under the arid conditions of southern Puerto Rico, better results were obtained by increasing the level and frequency of irrigation using the Pan Evaporation method. While we know from visits and observations that several farmers are adopting some of the recommended practices and technologies, we still don't have a more accurate indicator of this.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
132	Weather and Climate

Outcome #3

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

2. Associated Institution Types

•1862 Research

3a. Outcome Type:
Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The alarming rate of introduction of invasive species in Puerto Rico and the recurrent damage of hurricanes and forest fires in our reserves are conceived as major threats to our ecosystem. Stakeholders concerned with these issues include personnel from the Departments of Agriculture and Natural Resources, the Dry Forest Coalition, government officials, extensionists and the general public who travels and visit forest reserves.

What has been done

Research in this area has been used as a teaching tool in undergraduate and graduate courses. Undergraduate and graduate students have been trained in forest and invasive species management. Several seminars and workshops have been presented to broad audiences about these topics. Project directors are active participants in task forces created to address the threats posed by several particularly damaging invasive species.

Results

Progress is being made in the development of environmentally sound control methods for the Harrisia Cactus Mealybug, which is adversely affecting cacti in the dry forest reserve. Promising natural enemies are being identified locally and abroad for the implementation of a classical biological control program. Findings from dry forest research on species regeneration after hurricanes show that the multi-stemmed growth habit of dry forest trees can be generated naturally by hurricanes without breaking stems. This increases the value of forest stands in the perception of managers and the public because these lands are no longer assumed to be degraded. These findings are changing the understanding of scientists, forest managers, citizens, and government officials about the natural regeneration methods of the tropical dry forest.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity

Outcome #4

1. Outcome Measures

Number of farmers adopting methods to increase soil organic matter content

Not reporting on this Outcome for this Annual Report

Outcome #5

1. Outcome Measures

Number of farmers reporting increased water use efficiency in their farms

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	40	15

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The adoption of technologies that can potentially improve water conservation and crop yield is particularly important in the arid south coast, where most of the large commercial fruit and vegetable operations are located. Irrigation is a resource with a high energy demand; maximization of crop water use efficiency is essential. This indicator is closely related to the one on the adoption of microirrigation management practices.

What has been done

Several trainings, workshops and seminars have been given to extensionists and farmers to promote water conservation through watershed protection, irrigation techniques, and drip irrigation management.

Results

Several farmers have adopted the watershed conservation practices and microirrigation techniques, presumably reducing the contamination of the aquifers, production costs, and fertilizer losses, but more precise data based on a survey of farmers' on-farm results is still lacking.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management

Outcome #6

1. Outcome Measures

Number of persons that adopted practices to improve water resources.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	0	7

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Water for farming is increasingly an island-wide issue as other sectors put forward competing demands for this resource. Water quality concerns are particularly present in the coffee region due to the water-intensive processing of this crop. Farmers, extensionists, government officials and the general public need to have access to better information tools on water conservation and management to be able to make informed decisions with respect to the future of this resource.

What has been done

Studies documenting the impact of coffee processing on the Saliente basin of central Puerto Rico. Workshops and seminars on these topics.

Results

Studies on the impact of coffee processing activities on the nutritional status of river waters showed that these activities did not exert any significant deteriorating impact on water quality, except at one sampling point where elevated nitrate concentrations were consistently detected due to the presence of an abandoned landfill upstream the coffee processing plants on this watershed. Following recommendations devised by researchers, extension and natural resources agencies, coffee producers have been adopting ecological processing technologies. These results could help coffee producers document their compliance with water quality standards when required to do so by regulatory agencies.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

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

Not reporting on this Outcome for this Annual Report

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Competing Programmatic Challenges
- Other (Lack of reliable mechanisms to assess the program's impact)

Brief Explanation

This program encompasses several research groups efforts and it is difficult to document outcomes and adoption of management practices in all of them. We believe that many indicators are numerically larger than the conservative estimate offered, but at present lack concrete evidence of this.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Before-After (before and after program)
- Other ()

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

Program #5

V(A). Planned Program (Summary)

1. Name of the Planned Program

Agricultural Economics, Marketing, Value Added and Community Development

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management			30%	
604	Marketing and Distribution Practices			35%	
606	International Trade and Development			8%	
607	Consumer Economics			7%	
608	Community Resource Planning and Development			12%	
610	Domestic Policy Analysis			8%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.1	0.0
Actual	0.0	0.0	2.1	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	31864	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	57359	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

During fiscal year 2008, research was performed to determine consumer preferences, marketing margins, and farmers' and other participant's shares in the marketing channels of selected agricultural commodities. A study aimed at estimating costs of producing ornamental crops was initiated. Also, research was conducted to identify the diverse strategies that local food system stakeholders are currently using or might use to create and manage ongoing or potential change. Efforts included participating in meetings with environmental and labor organizations with an interest in land use policy and food security issues. In collaboration with Extension Faculty and Agents, results were translated into recommendations for farmers and community organizers. Publications were prepared and presentations were made to producers' associations and agricultural professionals.

2. Brief description of the target audience

Farmers, Extension professionals, community leaders and organizers, producers associations and other professionals.

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
Plan	0	0	0	0
2008	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	0
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan	0	1	
2008	0	3	3

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of refereed publications

Year	Target	Actual
2008	1	3

Output #2

Output Measure

- Number of presentations in scientific meetings

Year	Target	Actual
2008	2	5

Output #3

Output Measure

- Number of non-refereed publications (posters, newspaper articles, etc.)

Year	Target	Actual
2008	2	12

Output #4

Output Measure

- Number of participants attending workshops coordinated with Extension on program's results

Year	Target	Actual
2008	70	570

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Number of stakeholders gaining knowledge about new markets and marketing tools
2	Number of alternative marketing projects identified as existing in Puerto Rico (long-term)

Outcome #1

1. Outcome Measures

Number of stakeholders gaining knowledge about new markets and marketing tools

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	20	590

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
607	Consumer Economics
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices
608	Community Resource Planning and Development

Outcome #2

1. Outcome Measures

Number of alternative marketing projects identified as existing in Puerto Rico (long-term)

Not reporting on this Outcome for this Annual Report

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Other (Termination of projects.)

Brief Explanation

For the last five years we had a project researching the opportunities and constraints faced by emerging farmers' markets in the island. This project terminated in 2008, and although research and education on improved marketing tools continues to be a priority of the program, we thought that given the prevailing economic conditions in Puerto Rico, the creation of new alternative marketing projects might not be a reasonable measure of the Program's outcomes. We still need to discuss and develop other alternative indicators that can potentially portray the progress achieved in meeting the Program's objectives.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Other (Focus group)

Evaluation Results

Key Items of Evaluation

Program #6

V(A). Planned Program (Summary)

1. Name of the Planned Program

Food Science, Safety and Technology 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
501	New and Improved Food Processing Technologies			29%	
503	Quality Maintenance in Storing and Marketing Food Products			43%	
504	Home and Commercial Food Service			14%	
701	Nutrient Composition of Food			14%	
	Total			100%	

V(C). Planned Program (Inputs)

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

Year: 2008	Extension		Research	
	1862	1890	1862	1890
Plan				
Actual	0.0	0.0	2.2	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	37717	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	49656	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	32147	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

During FY 2008-09 investigators continued to work on their search for external funding to address the research needs identified by the Agricultural Experiment Station. One full-time researcher left the University due to health and personal reasons. Major program efforts were focused on the set-up of the recently built facilities for the Food Science and Technology program. This effort continues and is expected to last until late 2009.

2. Brief description of the target audience

- Producers and Commodity Groups
- Food Industry/Manufacturing
- Consumers
- Federal and State Agricultural Agencies (PRDA, USDA/APHIS, USDA/ARS, USDA/NRCS)
- Extension Specialists and Agents
- Academic Programs Faculty and Students

V(E). Planned Program (Outputs)

1. Standard output measures

Target for the number of persons (contacts) reached through direct and indirect contact methods

	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	**Target**	**Target**	**Target**	**Target**
Plan	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
2008	0	0	0	0

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

Patent Applications Submitted

Year	Target
Plan:	
2008 :	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

	Extension	Research	Total
Plan			
2008	0	4	4

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of courses, seminars and workshops

Year	Target	Actual
2008	{No Data Entered}	10

Output #2

Output Measure

- Number of industry collaborations/projects

Year	Target	Actual
2008	{No Data Entered}	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O No.	OUTCOME NAME
1	Number of enterprises impacted by the program.
2	Food manufacturing exports in dollars.

Outcome #1

1. Outcome Measures

Number of enterprises impacted by the program.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	{No Data Entered}	30

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Research should not be detached from the food industry. These interactions keep faculty aware of industry needs, thus, updated, focused and better positioned to prepare students to address such needs. These collaborative projects, not only fulfill such intent, but often allow students to enter the industry world and obtain first hand experiences.

What has been done

There are two types of collaborations with industry: projects and services. Services refer to microbiological, chemical or nutritional analysis performed at industryÂ's request on a given product sample. Projects refer to larger product or process development efforts that last for several months. The above metric includes both types.

Results

During 2008-09, a collaborative project with the local brewery allowed for a student to perform a process characterization at their manufacturing plant. This effort should continue until late 2009. Also, 29 service requests were addressed.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
501	New and Improved Food Processing Technologies

Outcome #2

1. Outcome Measures

Food manufacturing exports in dollars.

2. Associated Institution Types

•1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2008	{No Data Entered}	4943000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

This program attempts to positively impact the islandÂ's food-industry-related economy. One of the indicators of such economy is the amount of goods exported. The rationale is that the more we support the industry, the stronger it will become. As a result, local industry will be able to shift from production for the local market only, to production to satisfy both local and international markets.

What has been done

Provide technical support in the form of training and services to ensure compliance with quality standards, federal regulations and quality system requirements. Support local industry and commodity groups in the development process of new production lines and products. Perform research in identified areas of need.

Results

It is not possible yet to determine whether the increase in exports experienced during FY 2008 resulted from our efforts to any extent. Nevertheless, the level of interaction of the program's resources with food industry stakeholders was significant.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
501	New and Improved Food Processing Technologies

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Other (Faculty turnover.)

Brief Explanation

Economy – As in the rest of the world, Puerto Rico is currently suffering from an economic recession. While the recession prevails, the amount of funding available to invest in research or new ventures will be limited.

Turnover – Program performance was affected by the departure of the only faculty member fully devoted to research in the field. The position remains vacant, but there are plans to hire a replacement.

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

-

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}