2011 University of Puerto Rico Research Plan of Work

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I. Plan Overview

1. Brief Summary about Plan Of Work

The mission of the University of Puerto Rico Agricultural Experiment Station (AES) 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, farming operations, public and private institutions, and rural development. The AES coordinates its academic activities with the teaching and extension faculty of the CAS, and incorporates into its research program the faculty of these other two institutional branches. 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, however, incorporate the collaboration of Extension faculty in the activities proposed to disseminate results. Many programs 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. To advance regional goals, the AES also participates in both multistate research and Special Grants from USDA-NIFA that target agriculture in the Caribbean Basin territory of the United States.

This POW receives input from stakeholders during yearly meetings of commodity groups and during workshops and field days. It also ponders recommendations received from farmers' organizations as well as from government officials who directly contact AES staff. This input helps to identify major constraints to agricultural production and to establish priorities that should be targeted by our research programs. We continue to conduct annual commodity group or research program meetings in which the progress of projects is discussed. Preliminary results are shared, and further input is sought for updating the commodity's research needs and priorities. All of our project proposals, formula funded or otherwise, go through a thorough merit review process, following the appropriate administrative manuals. 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 locally competitively granted.

In contrast with most mainland states, in Puerto Rico the links between agricultural production and food consumption were gradually weakened during the second half of the 20th century. As agriculture lagged behind the growth of other economic sectors such as manufacturing, service, and government, the expanded consumption of the population was gradually supplied by imports, distributed mostly through large supermarket chains. By 2006 the agricultural sector's contribution to the Gross Domestic Product (GDP) was less than 1%. Recent statistics show the continuation of this trend. The 2007 Census of Agriculture depicts an 11% decline in farm numbers and a 19% decline in land in farms since 2002, even though local Department of Agriculture data show positive growth in several subsectors such as livestock products, ornamentals and other specialty crops.

Overall figures, however, do little to convey the continued vital role played by farming in the economy of Puerto Rico. This critical role includes fostering demand for other final and intermediate goods, creating employment in areas where alternative opportunities do not abound, supplying produce for domestic consumption and local processing plants, and preserving the island's natural resources from alternative urban uses--potentially more damaging to a fragile tropical island ecosystem. The University of Puerto Rico College of Agricultural Sciences, through its research and education programs, has been an important contributor to the development of enterprises that have had a positive impact on the island's economy. Through technologies that improve and promote diversified agricultural production systems, the CAS has also helped halt the decline of traditional agricultural systems.

Current trends in global markets, and the challenges they pose to the continued viability of food and agroindustrial operations in Puerto Rico, underline even more the role that a responsive research program can play in the search for alternatives to the needs of stakeholders. Although the North American (NAFTA) and Central American-Dominican Republic Free Trade Agreements (CAFTA-DR) have up to now exempted Puerto Rico from its market-pricing policies, it is

unclear whether these exemptions will expire in the future, and how they will affect our agricultural sector, particularly coffee, which has enjoyed a protected status since the 1930s. Moreover, changing market forces, such as the consolidation of wholesale and retail distributors, coupled with technological innovations and changing consumer behavior, have dramatically transformed the way in which food business is conducted on the island and the market share of local agriculture in the total food trade. To maintain and regain part of agriculture's competitive position, research must be directed to the analysis and solution of problems stalling production, and to the search of alternative uses and markets for our products.

Since our initial 2007 POW submission, however, important changes have occurred in the global economic system and in the world's food and agriculture situation. In Puerto Rico, increases in the price of farm inputs have undermined the already weak position of the island's agriculture, while the prolonged fiscal crisis has reduced the amount of local government payments and subsidies to farmers. The situation of the most important local commodities has been further complicated by the introduction of new devastating pests and diseases, such as the coffee berry borer (*Hypothenemus hampei)*, the black sigatoka *(Mycosphaerella fijiensis)* in plantains and bananas, and, most recently, of citrus greening (*Huanlongbing*) in citrus fruit orchards.

Rising imported food prices have, nevertheless, attracted increased public attention to Puerto Rico's fragile food security, and to the urgent need to adopt measures to protect agricultural resources and augment the output of the farm economy. While the state university system is facing budget cuts which certainly affect our overall long-term planning and ability to strengthen all research programs, additional efforts are being made to refocus priorities and to invest in those areas considered critical to the maintenance of our food system and natural resources. Aware of the connections between climate change, new invasive species threats, and the need to improve the island's food security, we are currently reconverting underutilized laboratory space at our Rio Piedras center into a *Certified Quarantine and Beneficial Insect Rearing Facility*. The quarantine facility, financed by pooling local and external resources and leveraged by our formula-funded projects and faculty, will enable the laboratory to develop biological control technologies for invasive pests entering Puerto Rico, or threatening the U.S. through the Caribbean pathway. Strategically, we expect this initiative to help our Integrated Management of New and Emerging Pests (IMNEP) and Natural Resources and Environment (NRE) programs to develop systematic methodologies for dealing with exotic pests in the areas of (1) risk assessment, (2) early detection and invasion pathway analysis, (3) rapid development of control or eradication measures and, (4) improved sustainable pest management practices through biological practices.

In addition, renewed government-academia collaborations are being forged to promote farmers' entrepreneurial skills and output increasing technologies. In 2008 the state legislature approved a law allocating additional funds to the local Department of Agriculture (DA) for the applied research of urgent problems, amenable to relatively rapid solutions, faced by the island's agriculture and food production industries. We have already implemented two competitive calls for proposals for these funds, and we have initiated several projects directly targeting the priorities identified by the DA. In the short run, additional measures are being taken within the CAS to quickly extend research-based farming alternatives to interested stakeholders, and to educate consumers on the benefits of supporting our local farm sector. Mid-term initiatives already begun include the prospective establishment of integrated research and extension programs in the areas of food science and technology, meat production, and integrated pest management.

We are also intent on helping farmers succeed in the new local niche market for organic products. Last year a pilot organic farm was established in one of our agricultural experiment stations. Information on organic farming adapted to local conditions had been a recurrent request of some of our stakeholders. Researchers interested in addressing these needs were constrained by the lack of certified organic land in our centers, or on private farms. With institutional support and leadership, we finished an integrated management plan for the organic pilot farm and are currently applying for certified organic transitional status. External funding was secured for two initial research and demonstration projects. We envision this initiative as the fulcrum of a broader effort to expand, in this location, research in sustainable agriculture, renewable energy, and agro-forestry research and education.

New farm bill provisions emphasizing competitive research funding and interest in promoting these integrated research and extension collaborations require changes in the local institutional culture of research development, technology diffusion, and adoption. To promote increased faculty collaboration and training in the adoption of transdisciplinary methodologies, an internal request for proposals for Hatch-funded projects was drafted emphasizing systems-based, interdisciplinary approaches to high priority problem areas. We will continue to support, within the limits of our resources, ways to position our faculty to be more competitive in externally funded initiatives that address our stakeholders' needs. Nevertheless, the current unstable panorama regarding long-term funding of programs limits our ability to predict whether indeed the new research and extension collaborations will be duly institutionalized, and to decide which programs will need to be curtailed.

Although we are aware of the need to recruit more scientists to strengthen several of our programs, we realize that with projected resources we will be able only to replace retiring faculty and perhaps recruit a few more scientists in order to fully

operate new facilities, to attract interested post doctorates and graduate students, and to address our changing local and national priorities. Most of our current research is aligned with national priorities of improving the situations of global food security and hunger, climate change, and food safety. Research on sustainable energy alternatives is only beginning to be addressed. Research on childhood obesity is limited to a couple of initiatives, mostly led by the Agricultural Extension Service.

This Plan of Work is probably the last one in which we will be giving follow-up to research programs organized in 2005, following federal guidelines at that time. During this year we will reorganize the administrative structure of research and the focus of programs under new categories, both to facilitate reporting under the new Guidance, and to convey the message that we need not only to evaluate, and provide continuity, but also to recontextualize our efforts to better meet changing local and global needs.

Estimated Number of Professional FTEs/SYs total in the State.

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	55.1	0.0
2012	0.0	0.0	56.1	0.0
2013	0.0	0.0	56.1	0.0
2014	0.0	0.0	56.4	0.0
2015	0.0	0.0	57.1	0.0

II. Merit Review Process

1. The Merit Review Process that will be Employed during the 5-Year POW Cycle

- Internal University Panel
- Expert Peer Review

2. Brief Explanation

There has been no significant change in our Program Review Process since our 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-NIFA 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.

III. Evaluation of Multis & Joint Activities

1. How will the planned programs address the critical issues of strategic importance, including those identified by the stakeholders?

As previously explained, this POW incorporates the input of researchers and stakeholders who have attended workshops, seminars and commodity group meetings during the past years. During these activities, participants attempt to identify the most pressing needs that should be addressed by the AES research program. Because the AES cannot address all the issues identified at the same time, annual meetings of the commodity groups continue to be held to evaluate research progress and to reassess research priorities. The list of priorities assembled through this process will be reviewed by each program coordinator and the CAS administration, and final recommendations will be prepared for the year's call for proposals for new Hatch and Special Projects. Researchers are also encouraged to review this final list of priorities when applying for grants financed by external funds.

Progress toward AES goals will be monitored by the indicators included in this POW and discussed in the yearly program and commodity meetings. Additional program meetings will be planned by the areas' coordinators with participation of extension faculty, to work on the incorporation of research results updating technological alternatives present for a particular problem, into the recommended management practices for different commodities, or agroindustrial processes.

In addition, new funds allocated by the local legislature for the solution of pressing needs of the agricultural sector will be distributed through a yearly request for proposals (RFP) that will include the priorities identified by the local DA's committee for Research and Development of Agricultural Technology. This committee has representatives from farmers' organizations, agroindustries, the Department of Economic Development and Commerce, and our CAS. We envision this process as an opportunity to develop projects targeting more immediate critical situations, while liberating other institutional funds for more complex research problems requiring a longer term commitment and an integrated interdisciplinary approach toward solutions.

2. How will the planned programs address the needs of under-served and under-represented populations of the

A truthful evaluation of this question in the context of Puerto Rico requires further specification. Puerto Rico's population is almost totally Hispanic, with 45% of families living below the federally defined poverty line. In addition, joblessness is much higher than in any of the 50 states. Therefore, the vast majority of the island's population qualifies as "under-served and under-represented" citizens in Federal government Programs. Moreover, compared with the assistance that other sectors such as manufacturing have received over the years, agriculture and rural areas in general, have lagged behind in public investment by the Commonwealth government. In this context, this POW planned programs efforts towards the enhancement of natural resources and towards the analysis and managed solution of problems affecting agriculture, with the ultimate goal of increasing the competitive production of our commodities and raise the employment level of the population, is addressing the stated needs of a critical sector and its underlying population.

The above statement does not invalidate the need to further analyze regional and sub-sectors disparities that may still be present in our programs. Within our personnel and budget limitations this POW incorporates measures to ensure that research will benefit organic farmers, small-scale farmers with low educational levels, and rural communities in need of better decision making tools to deal with pressing public policy issues such as agricultural land preservation in land-use plans. All planned programs, for example, include the formation of integrated work groups between researchers and extension specialists, both to conduct the work planned and to translate research results into educational materials for a broad audience. This includes tailoring best management practices (BMPs) to different scales of production, varying cropping systems, and the range of soil and climatic conditions found in Puerto Rico. Research on tropical organic systems has been included into the priorities of several commodities, and three projects are underway to promote environmentally friendly organic management practices in the island and develop an organic seed production program. In addition, steps are been taken toward certification of a small organic experimental farm in one of our experiment stations. Collaboration by researchers in extension initiatives related to public policy issues and in a new Southern Extension and Research Activity on this topic is also underway. Altogether, this POW implementation involves the continued education of researchers on the diversity of stakeholders in Puerto Rico and on the need to incorporate their concerns into our programs.

3. How will the planned programs describe the expected outcomes and impacts?

Each program has designed several outcomes to monitor progress. These indicators will be evaluated periodically to make adjustments needed to achieve the desired impacts. Most programs plan to record information about participants in program activities to follow-up on adoption of recommendations, or to assess factors affecting the achievement of the planned goals. Some programs will use official records (of commodity production, water quality in a watershed, sales of improved seeds, etc.) to monitor the impact that program interventions may have had upon the targeted population. Other programs will need to design a study to assess if the expected impacts are being achieved. At present, there is no division in our institution specialized in evaluation studies or in monitoring the impact of our research and extension programs. This deficiency will need to be addressed by the CAS administration as we progress in our plan, within the limits of the resources available.

4. How will the planned programs result in improved program effectiveness and/or efficiency?

An effective coordination of research, extension and academic activities is needed to achieve intermediate results and long-term impacts. While there has been an historic connection between these three activities, this is the first time CAS researchers will have to report progress and impacts of research beneath the traditional publications, theses, seminars and field days reported in annual reports. Similarly, while extension education programs are often based on research results, participation by extensionists in research needs to be expanded, particularly in the adaptation of research results to local production systems. Integrated research and extension projects have had important successes in the past that should help model the new integrated programs. Nevertheless, as is the case with other aspects of this POW, only periodical monitoring of the programs' progress will help determine if the program is being effective and help identify ways to improve efficiency.

Our stakeholders are a very diverse audience. Some of their problems are amenable to technological solutions while others are more complex, market and resource-related issues deserving further study and possibly new public policy interventions. To improve and promote integrated research and extension approaches to those areas in which we share similar goals and in which there are technological recommendations for present problems, we chose last year one program in which researchers and extension specialists were to meet periodically and coordinate educational activities for both extension agents and producers. This pilot collaboration involves our Integrated Management of New and Emerging Pests program and Extension's Crop Protection Program. During this past year a new collaborative effort was initiated to determine the spread of citrus greening, and a working group was organized with Extension and DA officials to prepare an emergency response. We will continue monitoring the progress of this initiative and expect to implement similar collaborations in the future with other Extension programs for which wehave a research counterpart.

IV. Stakeholder Input

1. Actions taken to seek stakeholder input that encourages 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 will continue 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. 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 will continue to organize thematic workshops, seminars, and field days where research results will be shared and

the research and extension needs, or public policy determinations, will be discussed.

2(A). A brief statement of the process that will be 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 are 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 will be 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 individuals

Brief explanation.

Input from stakeholders is collected at the meetings conducted by commodity and program leaders. Stakeholders are asked 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 will be considered

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

Brief explanation.

The input received in these meetings from all the stakeholders present is summarized, evaluated and presented in a concluding meeting of commodity leaders, program coordinators and research administrators, where final decisions are taken. The list of priorities assembled through this process guides the year's call for proposals for new Hatch and Special projects. When there are issues which need to be emphasized, programs are redirected to address these issues. This process may also inform decisions about recruiting new faculty members.

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Milk and Meat Production Systems Resources

2. Brief summary about Planned Program

Given the importance of livestock industries in the agricultural economy of Puerto Rico, the AES research program in Milk and Meat Production Systems has a wider scope--in terms of commodities and problem areas--than that targeted by our federally-funded research projects. Formula funded research is concentrated in the dairy industry, including forage production systems, and to a lesser degree, in beef cattle.

Research and outreach to stakeholders under this program area has the primary objective of supporting the commercial livestock and poultry industries of Puerto Rico, the most important of which are bovine milk, beef and broiler production, along with smaller contributions to farm income from the sale of pork, eggs, replacement dairy heifers, commercialized forages, and meats from other classes of fowl, rabbits and small ruminants. Non-food animal production includes race horses, "paso fino" horses, pleasure horses and fighting cocks, to which some previous research effort has been dedicated in former years but not so at present.

Current research is directed toward alleviating the inordinate dependence of local animal production on imported concentrate feed. By developing new forage resources and by improving forage management we hope to achieve production of high quality material capable of supplying an important fraction of the nutrient requirements of ruminant livestock. We continue the search for, and testing of, local agro-industrial byproducts as new feed resources. Other important goals are to mitigate environmental stress factors such as high ambient temperature and humidity, and thus to promote animal comfort, and to incorporate other practices that favor herd health. Our program of beef cattle research seeks to improve animal genotypes and to produce pasture-fed animals yielding meat of low-fat content but good tenderness characteristics. This program also fosters effective marketing of local beef. In spite of the relatively small contribution to farm income, small ruminant production is deemed to have good potential in Puerto Rico and is being supported by research on feeding, management and internal parasite control. At present swine research is limited mostly to reproductive aspects, whereas research with poultry is at low ebb because the two scientists of our Department with this specialization are occupying full-time administrative positions and because the required new physical facilities have remained incomplete for the past several years.

3. Program existence : Mature (More then five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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			5%	
205	Plant Management Systems			5%	
301	Reproductive Performance of Animals			15%	
302	Nutrient Utilization in Animals			15%	
303	Genetic Improvement of Animals			15%	
305	Animal Physiological Processes			5%	
306	Environmental Stress in Animals			10%	
308	Improved Animal Products (Before Harvest)			10%	
311	Animal Diseases			5%	
313	Internal Parasites in Animals			5%	
403	Waste Disposal, Recycling, and Reuse			5%	
601	Economics of Agricultural Production and Farm Management			5%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

In view of the high cost of imported concentrate feed, improvements in the optimal use of well-managed pastures and other highly nutritious forages is a major goal, especially with regard to dairy cattle feeding. Local production of feed grains to lessen the need for imports for use in feeding both ruminant and non-ruminant livestock and poultry would obviously be desirable, but the feasibility of local production of these grains is a matter of debate. Local production of corn (maize) grain has been proposed on the basis of theoretical calculations but production on a large scale has yet to be attempted. Other scientists with pertinent expertise are dubious about local corn grain production, but consider production of grain sorghum to be a real possibility, because of lower water and fertilizer requirements, less susceptibility to insect and disease damage, and easier weed control with this crop as opposed to corn production. Promising grain varieties of both corn and sorghum have been identified in previous studies.

Locally generated agro industrial by-products include glycerol, which results from the conversion of used cooking oil into diesel fuel. In other countries glycerol has been successfully incorporated into dairy rations as a partial substitute for grains, such as corn, whereas a first experiment of this sort in Puerto Rico yielded inconclusive results. A second experiment is to begin by the end of February 2010. Morus alba has been studied locally for several years as a forage, and its digestibility for ruminants has been found to nearly equal that of common concentrate feeds. Therefore, it has been proposed by a local producer of small ruminants, and entrepreneur of value-added foods, that whole plants of this crop could be dried, ground and pelleted to make an ingredient with the capacity of partially substituting for other concentrate ingredients in ruminant diets. Whether such a scheme could be economically feasible is unknown, as the lack of pertinent data precludes any reliable cost/benefit estimates. Preliminary work on this topic on a small scale could begin to supply some of the missing information needed for feasibility estimates.

Under these circumstances, and given our current research and extension resources, the following four priorities summarize the main foci of our program during the next years:

- Development of new forage resources and improvement of forage management to achieve production of high

quality material capable of supplying an important fraction of the nutrient requirements of ruminant livestock.

- Development and evaluation of management practices for reducing the effect of environmental stress on productivity and reproductive efficiency under tropical conditions.
- Improvement of beef cattle animal genotypes to produce pasture-fed animals yielding meat of low-fat content but good tenderness characteristics.
- Evaluation of feeding systems under tropical conditions for increasing feed efficiency for more milk and meat production.

2. Scope of the Program

- In-State Research
- Multistate Research

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

(1) Scientists working in this Program will continue to identify additional Recommended Management Practices (RMP) for the various classes of livestock in question.

(2) RMP of proven effectiveness will be communicated to commercial livestock producers through the efforts of Agricultural Extension Service Specialists and Municipal Agents and by field days for stakeholders organized by researchers and extensionists.

(3) Adoption of the RMP by a majority of the local producers will be a gradual process, but the unavoidable need of operating with sufficient biological and financial efficiency to compete in today's globalized market will exert pressure in this direction.

(4) Improving the production efficiency and final quality of local meats will help increase the demand for the local product.

(5) The institutional funding for new projects and staff needed to conduct this program will be available.

2. Ultimate goal(s) of this Program

To achieve greater on-farm efficiency of livestock production based on a firm foundation of scientific knowledge gained through research and verified through practical experience. On farm efficiency can be attained through the following measures: utilization of high-quality forages and other relatively inexpensive local feed resources; genetic selection to improve animal fitness and productivity; enhanced heat detection, insemination and other reproductive management practices; use of physical facilities to promote animal comfort; and careful attention to sanitation and herd health. Greater efficiency of operation and the use of modern technology at the farm level will benefit both the economic returns of producers and the price and quality (sanitary, organoleptic and nutritional) of locally produced meat and dairy products available to the public.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	10.5	0.0
2012	0.0	0.0	10.5	0.0
2013	0.0	0.0	10.5	0.0

Year	Extension		Research	
	1862	1890	1862	1890
2014	0.0	0.0	10.5	0.0
2015	0.0	0.0	10.5	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

(1) Maintain communication with Commodity Leaders ("Empresas") and principal active researchers in projects to promote reasonable progress of research endeavors during the year.

(2) Encourage principal investigators to submit for publication the results of completed experiments without undue delay and to urge scientists with a backlog of unpublished experimental results to make an effort to correct this situation; attempt to foster the participation of students in writing a paper for publication in a refereed scientific journal in the case of experimentation that serves as the basis of MS theses. When this attempt is unsuccessful, to encourage the President of the Thesis Committee to write the paper and include the student as coauthor.

(3) Continue to produce and distribute the serial extension-type publications "La Res Informativa" (for beef cattlemen) and "Ruminantía" (for producers of small ruminants).

(4) Continue the process of compiling a list of Recommended Management Practices (RMP) for each class of livestock with input from all scientific personnel of the College of Agricultural Sciences with pertinent expertise; and to characterize these RMP as far as possible with regard to time required for their implementation on commercial farms plus observation of expected results, and with regard to the relative difficulty and cost of implementation.

(5) In collaboration with extensionists, organize events for stakeholders for communicating useful research findings and for persuading producers to adopt RMP; also for seeking stakeholders' opinions regarding RMP already listed and others that are candidates for listing.

(6) Organize field days and training sessions in which producers acquire useful knowledge and skills with emphasis on witnessing RMP in action.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

(1) Commercial scale producers of the following types of livestock and related products: bovine milk, beef cattle, sheep and goats, swine, rabbits, poultry, and forages for sale.
(2)Agricultural Extension Service Specialists and Extension Agents and personnel of the Department of Agriculture of Puerto Rico and of USDA.
(3)Representatives of supporting industries such as feed mills, drug companies, machinery and equipment vendors, and seed companies.
(4)Private enterprise professionals, such as practitioners of consulting services.

(5)Students of agricultural sciences of the Mayagüez and Utuado Campuses of UPR and vocational agriculture students (high school level).
(6)Interested members of the general public.

V(G). Planned Program (Outputs)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0

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

2011:0 **2012:**0 **2013:**0 **2014:**0 **2015:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2011	7	0	0
2012	7	0	0
2013	8	0	0
2014	8	0	0
2015	9	0	0

V(H). State Defined Outputs

1. Output Target

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

2011:6 **2012:**6 **2013:**6 **2014:**6 **2015:**6

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

2011:5 **2012:**5 **2013:**5 **2014:**5 **2015:**5

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

2011:6 **2012:**6 **2013:**6 **2014:**6 **2015:**6

- Number of publications made in refereed scientific journals.

2011:7 **2012:**8 **2013:**8 **2014:**9 **2015:**9

V(I). State Defined Outcome

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 Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

2011:36	**2012:**36	**2013:**36	**2014:**36	**2015:**36

3. Associated Knowledge Area(s)

- 205 - Plant Management Systems
- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 306 - Environmental Stress in Animals
- 601 - Economics of Agricultural Production and Farm Management

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

% market participation of local beef.

2. Outcome Type : Change in Condition Outcome Measure

2011:13	**2012:**14	**2013:**15	**2014:**16	**2015:**17

3. Associated Knowledge Area(s)

- 302 - Nutrient Utilization in Animals
- 306 - Environmental Stress in Animals
- 308 - Improved Animal Products (Before Harvest)
- 601 - Economics of Agricultural Production and Farm Management

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)
- Other (See text)

Description

Economy - Public finances have been a serious problem in recent years. If government revenues do not begin to rebound in 2010, further deep cuts in our research and extension budgets can be expected, unless a substantial increase in external funds can be achieved.

Vagaries of weather and extreme atmospheric phenomena - A large part of the land devoted to pasture and harvested forages crops depends on rainfall as the water source. Prolonged droughts in certain regions of the island have occurred frequently in the past and undoubtedly will continue to occur in the future, with obvious negative effects on agricultural and livestock productivity. At the other extreme, excessive rainfall and flooding can also be destructive to agricultural production and is not infrequent in Puerto Rico, especially during the hurricane season. Animal health problems, including respiratory infections, parasitism, foot rot and mastitis, also tend to be more frequent and more severe during periods of excessively humid conditions.

High unemployment rate and reduced purchasing power of the consuming public of Puerto Rico - In the latter part of 2009 and continuing in the early months of 2010 thousands of public sector employees have been laid off in Puerto Rico, adding to an already large pool of unemployed. The situation of declining personal income is noticeable in the closing of many local restaurants, with implications for the chain of food suppliers, including decreased demand for more select foods such as the most desirable cuts of meat.

Changing consumer habits - In the modern urbanized society of Puerto Rico many families do little meal preparation at home and depend mostly on pre-prepared foods supplied by fast food restaurants and super markets, which often use mostly imported supplies and purchase little of local agricultural products.

High costs of local livestock production - Local livestock producers must pay high prices for most of the necessary input such as concentrate feeds, synthetic fertilizers and other agricultural chemicals, tractors and other farm machinery and equipment, gasoline and diesel fuel, and especially land and labor. Under such circumstances a reasonable profit can be made only by efficient operations, whereas inefficient producers can be expected to leave the livestock business.

Competition from imported products of animal origin - Puerto Rico is at a disadvantage because of its lack of sovereignty and inability to protect local producers from the unfair competition of subsidized agricultural exports from developed countries, with the exception of coffee. Only efficient local production of high-quality food can overcome this obstacle to some degree.

Shrinking pool of human resources - Two specialists of the Agricultural Extension Service who worked in the dairy sector retired from active service during January and February of 2010, leaving only one part-time extensionist in this field. At present we do not know whether replacement personnel for these vacant positions will be hired.

Attrition of agricultural land base - Intense pressure to convert lands, including the most fertile flat lands, to non-agricultural uses.

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

1. Evaluation Studies Planned

- Other (Follow-up on Implementation)

Description

Field days and training sessions will expose producers to recommended management practices while explaining their benefits. At all such events we will request that the producers in attendance fill out a short and simple questionnaire in which they indicate the degree of their inclination to adopt the RMP in question by choosing among the options: (A) none, (B) minimum, (C) moderate, and (D) considerable. Producers selecting options C and D will be considered candidates for adoption of the RMP worthy of follow-up efforts on the part of

Agricultural Extension Service personnel. As the culmination of such efforts the extensionists will be expected to personally verify that the RMP has, in fact, been implemented on the farm.

2. Data Collection Methods

- Sampling
- On-Site
- Unstructured
- Observation

Description

The planned program will use qualitative methods and a simple evaluation form to collect data from prospective adopters of recommended technology at field days and training sessions.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Integrated Management of New and Emerging Pests

2. Brief summary about Planned Program

The aims of the IMNEP multidisciplinary program are to generate better alternatives to control new and emerging pests and diseases to ensure food availability. Research efforts will continue to request the input of stakeholders and potential partners towards a common definition of priorities and further implementation of new technologies. In this regard the augmentation of parasitoids to suppress new pests and the evaluation of biologically based disease control agents are critical. Continuing efforts will include the accurate diagnosis of pests and diseases through the collaboration with plant pathologists, entomologists and weed scientists from the Crops and Environmental Sciences Department (C&ESD). New initiatives oriented toward the transition to organic agriculture, and toward reduction of energy input and the effect on diseases will aid in the development and adoption of new technologies for resource-conserving practices. Workshops and field days will continue to be the likely venue for information dissemination to the program's clientele; faculty attendance at scientific meetings will expand the impact of research results.

Invasive species have received special attention with several initiatives: (1) to develop island-wide host vegetation maps (including crops and natural vegetation) and to correlate with predicted distributions of potentially invasive arthropods, and (2) to assess the relative risk which different ports of entry pose, based on interceptions and successful colonization by invasive species in the past. Studies in new invasive species have included *Raoiella indica,* to determine which species of native generalist predators reproduce, feed, and survive on a *R. indica* diet. We have conducted several surveys to determine the current infestation levels of the Chili thrips on the island, including ornamentals in nurseries. A similar Chili thrips survey has been planned for the south coast mango-growing area.

Basic information on the potential of shade plant species to harbor *Xylella fastidiosa* will be collected, including isolation and identification of endophytic bacteria found in shaded coffee and in other species associated with shaded coffee, such as citrus and river coco tree (*Inga vera*), and in nearby sun coffee plants. This research will assess the potential vector utilization of each host species.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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			20%	
212	Pathogens and Nematodes Affecting Plants			29%	
215	Biological Control of Pests Affecting Plants			17%	
216	Integrated Pest Management Systems			34%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

Significant accomplishments in pest and disease characterization have been reached. The implementation of molecular diagnostics led to the identification of Candidatus liberibacter asiaticus. A collaborative effort with the Extension Service was initiated to determine the spread of citrus greening and a working group was organized to prepare an emergency response. New records of the invasive species Androthirps ramachandra and Toumeyella parvicarnis will be published. The Diagnostic Clinic receives annually more than 800 samples. We plan to continue with diagnosis of pests and diseases of major crops of interest to the seed industry in Puerto Rico. In keeping with IMNEP mission of fostering food security the priorities will continue to be directed to 1) sustainable crop production with reduction of pesticide use by determination of optimal chemical spray options and development of pesticide efficacy; 2) alternative practices for control of arthropods, virus, bacteria and fungal diseases; 3) etiology and management of new and emerging pests and diseases; and 4) development of biological control technologies for invasive pests in the planned Center for Quarantine and Beneficial Insect Laboratory.

A more specific priority is the identification of effective fungicides to develop a management spray program to increase the efficiency in the control of Black Sigatoka (BS) in banana and delay the development of fungicide resistance. Evaluation of promising Musa sp. germplasm with resistance to BS in Puerto Rico will provide alternatives for banana and plantain production in the island. The coffee berry borer (Hypothenemus hampei) is causing losses in the main growing areas, and Beauveria bassiana is still the most promising fungus for biological control.

Implementation of activities on the resistance management program for Lepidopterous pests in horticultural crops will continue. This program will use sampling, natural enemy conservation, and principles of pesticide selection to lessen the economic impact of Helicoverpa zea. Six predaceous coleoptera species have been identified in association with the Harrisia cactus mealybug (HCM), Hypogeococcus pungens. These findings will be published in a journal and disseminated in two presentations directed to forest managers and environmental groups. Research potential of indigenous and commercially produced predators for biological control of the newly introduced red palm mite, Raoiella indica, in Puerto Rico is focused in three areas: biological control, tests with acaricides and the effect of R. indica on palm physiology.

Yield losses in watermelon, pumpkin, zucchini, melon and squash and incessant virus outbreaks have reduced the profitability from those crops. Work will be conducted to determine the inheritance of Papaya Ringspot Virus and Zucchini Yellow Mosaic resistance in genotypes of Cucurbita moschata. This work will advance the breeding program to incorporate resistance into local varieties. Field days and demonstrations will continue in collaboration with the Extension Service to demonstrate the integration of different practices developed by the projects.

2. Scope of the Program

- In-State Research
- Multistate Research
- Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

- Budget cuts will not affect the availability of resources at the University to conduct research properly.
- The scientists needed to develop this program are available.
- Personnel with adequate skills and knowledge of the research methods will be assigned to collaborate with the scientists.
- Agricultural Experiment Stations will be available to conduct research in different crops.
- The input of partners from Extension Service, USDA /APHIS, Puerto Rico's Department of Agriculture and producer groups will be available.
- IMP practices for the design of Pest Management Strategic Plans in important crops will be available.

2. Ultimate goal(s) of this Program

To decrease crop losses due to key and emerging pests and to decrease the damage inflicted upon the environment and health by unsuitable management practices. To integrate an outreach component with a new vision to ensure impact and adoption of new technologies developed.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	14.1	0.0
2012	0.0	0.0	14.1	0.0
2013	0.0	0.0	14.1	0.0
2014	0.0	0.0	14.1	0.0
2015	0.0	0.0	14.3	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

- Develop partner-mediated PMSPs for the crops of Puerto Rico.
- Develop biological control technologies for invasive pests
- Foster the use of cutting-edge technology to implement IPM.
- Enhance our capacity to conduct fast pest and disease diagnoses.
- Conduct research on 'reduced risk' pesticides.
- Greater integration of Outreach and Extension.
- Greater understanding of the needs and expectations of stakeholders
- Disseminate research results through publications, seminars, field days, conferences, and any other method deemed appropriate to reach our target audiences: extension specialists and agents, government partners, students, producers, consumers and environmental groups.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

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

V(G). Planned Program (Outputs)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0

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

2011:0 **2012:**0 **2013:**0 **2014:**0 **2015:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2011	5	0	0
2012	5	0	0
2013	5	0	0
2014	5	0	0

Year	Research Target	Extension Target	Total
2015	5	0	0

V(H). State Defined Outputs

1. Output Target

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

  2011:3 **2012:**0 **2013:**0 **2014:**0 **2015:**0

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

  2011:5 **2012:**5 **2013:**5 **2014:**5 **2015:**5

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

  2011:15 **2012:**15 **2013:**15 **2014:**15 **2015:**15

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

  2011:15 **2012:**15 **2013:**15 **2014:**15 **2015:**15

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

  2011:15 **2012:**15 **2013:**15 **2014:**15 **2015:**15

- 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.

  2011:3 **2012:**5 **2013:**5 **2014:**5 **2015:**5

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

  2011:5 **2012:**5 **2013:**5 **2014:**5 **2015:**5

V(I). State Defined Outcome

O. No.	Outcome Name
1	Number of stakeholders with increased knowledge on emerging pests and aware of non-target pesticide effects (Short Term)
2	Number of persons who adopted reduced risk pesticides and practices
3	Number of farmers reporting decreased losses due to key and emerging pests

Outcome # 1

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

2011:100	**2012:**100	**2013:**120	**2014:**150	**2015:**250

3. Associated Knowledge Area(s)

- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 212 - Pathogens and Nematodes Affecting Plants
- 215 - Biological Control of Pests Affecting Plants
- 216 - Integrated Pest Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of persons who adopted reduced risk pesticides and practices

2. Outcome Type : Change in Action Outcome Measure

2011:25	**2012:**50	**2013:**50	**2014:**100	**2015:**250

3. Associated Knowledge Area(s)

- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 212 - Pathogens and Nematodes Affecting Plants
- 215 - Biological Control of Pests Affecting Plants
- 216 - Integrated Pest Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Number of farmers reporting decreased losses due to key and emerging pests

2. Outcome Type : Change in Condition Outcome Measure

2011:25	**2012:**60	**2013:**60	**2014:**100	**2015:**100

3. Associated Knowledge Area(s)

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

- 215 - Biological Control of Pests Affecting Plants
- 216 - Integrated Pest Management Systems

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes

Description

Puerto Rico is frequently exposed to the impact of hurricanes occurring mostly between August and October. It is possible that increases in the frequency or intensity of hurricanes would favor the introduction of invasive species, and undermine efforts geared towards controlling the impact of key pests. Drought events in the major agricultural production areas of southwest Puerto Rico may also limit the outcomes of this program. Both federal and state appropriation changes due to the economic crisis are another source of concern, coupled with budget cuts at the university and changes in Faculty appointments due to the economic situation in the island.

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

1. Evaluation Studies Planned

- Other (Yearly baseline indicators)

Description

Timely and thorough assessment of program success and direction will be carried out to gauge accomplishments and needed corrections. Base-line indicators will be developed during the first program area meeting by scientists, extension specialists, and stakeholders. Progress monitoring of program outcomes will be tracked using these indicators, and evaluated by program scientists. New Program direction and indicators may arise and evaluated once each year.

2. Data Collection Methods

- On-Site
- Case Study

Description

Researchers, extension personnel and other stakeholders attending annual meetings will establish which indicators of progress are needed and how they will be collected. Surveys, case studies, and any other method deemed appropriate to collect the information of interest will be used.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Plant genetic resources, breeding and production systems

2. Brief summary about Planned Program

In recent years the value of crops produce represents from 35 to 41% of the gross agricultural income of Puerto Rico. Thus the plant breeding and production systems research program continues to be an essential component of the PRAES research activities. The development of improved varieties and better management practices has contributed to both the maintenance and the expanded production of many local crops. New trends in organic and hydroponic crop production in the tropics require research to solve the problems faced by these systems of production. The CAS has the expertise, facilities, the basic germplasm and breeding lines needed for continued development of improved cultivars as well as better field management of many traditional crops. Genetic improvement needs to be complemented by the improved efficiency of production systems, which include both traditional and new crops, especially when the high value of production inputs has dramatically increased the costs of production.

In order to address local problems, given our tropical environment and small farm system, much of the plant breeding and crop production research conducted in Puerto Rico is different from the agricultural research conducted on the US mainland. Our unique research capabilities produce plant germplasm, cultivars and recommended production practices that are of value to local producers as well as to those throughout Central America and the Caribbean. Accordingly, we plan to continue with the introduction of adapted germplasm that can be used to deal with specific production constraints, and to develop new cultivars of crops which can increase commercial yield, reduce production costs, increase marketing potential, and improve the overall profitability of local farming systems. Research geared towards the development of best management practices (BMPs) for traditional and non-traditional crops in Puerto Rico will also be conducted. BMPs will consider the need to develop production systems that conserve natural resources, improve efficiency, and promote biodiversity and natural services, such as biological nitrogen fixation and increases in soil organic matter content. The recently established organic pilot farm and other organic research projects begun in 2009 are expected to contribute to these goals.

3. Program existence : Mature (More then five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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 (Situation and Scope)

1. Situation and priorities

Germplasm collections of crops of economic importance in Puerto Rico are needed to provide material for propagation for commercial production. However, field collections of germplasm are currently under evaluation as to their importance to local breeding programs and the agricultural sector. New germplasm needs to be evaluated in order to identify accessions with traits of economic value to be incorporated into breeding programs or released for commercial use. The introduction of adapted germplasm can be used to address certain production constraints.

--A lack of availability of seed is an important factor limiting the production of many traditional crops. Breeding programs for crops such as pigeon peas, tropical pumpkin, and sweet cherry peppers do not exist in the private sector or in neighboring countries. AES plant breeders can develop lines with local adaptation and can respond to the emergence of disease or pest problems.

--There is a need to improve the efficiency of production systems of traditional and new crops. Non-conventional production practices, such as hydroponics and organic farming, have unique constraints that need to be addressed with research. Increased mechanization for small-and medium-scale farmers is needed to reduce labor costs. Cropping systems should take advantage of natural services such as the biological control of diseases and pests, organic matter increase and biological nitrogen fixation.

--A re-evaluation of the AES recommendations for traditional production systems is needed (i.e., fertilization, soil amendments use and irrigation practices) to provide our stakeholders with recommendations that permit profitable production and natural resource conservation.

--There is a need to develop management techniques for the profitable production of traditional tropical crops under organic and hydroponic farming systems.

Priorities:

*Introduction, evaluation and preservation of germplasm and cultivars of crops of economic importance in Puerto Rico.

*Development of new cultivars of crops of economic importance in Puerto Rico for conventional, organic and hydroponic systems of production that lead to increased yield, improve marketability of produce, lower production costs, or enhance value.

*Development of production systems that conserve natural resources, increase efficiency and promote biodiversity and natural services.

*Development of BMPs for traditional and non-traditional crop production systems in Puerto Rico.

2. Scope of the Program

- In-State Research
- Multistate Research

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

· Adequate long-term financial support for research will be maintained to permit plant-breeding programs to develop improved cultivars and germplasm, and to permit researchers to develop and to update recommended production practices.
· Scientists with the expertise needed to develop crop cultivars, to maintain genetic resources and to conduct crop production research are available in the College of Agricultural Science.
· A seed program will continue to function to insure the availability of seed for improved cultivars of traditional crops.
· Extreme weather conditions will not destroy field trials, germplasm collections or infrastructure needed to conduct research.

2. Ultimate goal(s) of this Program

To achieve wide-scale adoption of improved cultivars and of production practices that result in greater or more efficient crop production in Puerto Rico.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	17.0	0.0
2012	0.0	0.0	17.0	0.0
2013	0.0	0.0	17.0	0.0
2014	0.0	0.0	17.0	0.0

Year	Extension		Research	
	1862	1890	1862	1890
2015	0.0	0.0	17.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

- Development and release of improved cultivars of crops of economic importance
- Electronic publication of descriptions of germplasm collections
- Distribution of germplasm to scientists and the public
- Publication of technology packages describing best management practices for crops of economic importance
- 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.
- Increased on-farm research to validate new technology
- Publication of research results in bulletins for farmers and in refereed journals for scientists.
- Presentations of research results at scientific meetings
- Collect information from stakeholders on critical issues of importance to this program.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

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

V(G). Planned Program (Outputs)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2011	0	0	0	0
2012	0	0	0	0

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0

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

2011:0 **2012:**0 **2013:**0 **2014:**0 **2015:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2011	4	0	0
2012	5	0	0
2013	5	0	0
2014	8	0	0
2015	9	0	0

V(H). State Defined Outputs

1. Output Target

- Number of stakeholders to adopt the proposed BMPs.

  2011:125 **2012:**125 **2013:**125 **2014:**125 **2015:**125

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

  2011:1 **2012:**1 **2013:**1 **2014:**1 **2015:**1

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

  2011:1700 **2012:**1700 **2013:**1700 **2014:**1700 **2015:**1700

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

  2011:260 **2012:**260 **2013:**260 **2014:**260 **2015:**260

- Number of participants at the field days coordinated with Extension

  2011:135 **2012:**135 **2013:**135 **2014:**135 **2015:**150

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

  2011:130 **2012:**135 **2013:**135 **2014:**135 **2015:**135

- Number of refereed publications

  2011:4 **2012:**5 **2013:**5 **2014:**8 **2015:**9

- Number of non-refereed publications

  2011:4 **2012:**4 **2013:**4 **2014:**6 **2015:**6

- Number of presentations in scientific meetings

  2011:4 **2012:**4 **2013:**5 **2014:**5 **2015:**6

V(I). State Defined Outcome

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 Target

Number of stakeholders to adopt the proposed BMPs

2. Outcome Type : Change in Action Outcome Measure

2011:	**2012:**	**2013:**	**2014:**	**2015:**
125	125	125	125	125

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

2011:	**2012:**	**2013:**	**2014:**	**2015:**
118	120	125	125	125

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Appropriations changes
- Competing Programmatic Challenges

Description

Germplasm collections and field trials related to plant breeding or production research are vulnerable to adverse weather, particularly hurricanes and tropical storms. Some field trials can be conducted during seasons when severe weather is less likely to occur. However, some germplasm collections and field trials need to be planted during the hurricane season. The introduction of an exotic disease or pest could also threaten some crops. The proposed activities in the plan of work are dependent on continued programmatic and fiscal support of

the USDA and the Puerto Rico Agricultural Experiment Station.

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

1. Evaluation Studies Planned

- During (during program)

Description

Records of the planting material, or seed distributed for free, and of seed sales of cultivars developed by the Puerto Rico Agricultural Experiment Station will be maintained at the Substations. These records will provide a measure of the impact of the variety development program. The Puerto Rico Agricultural Experiment Station websites containing the crop production technology packages will solicit comments and suggestions from the readers. Number of hits on the web sites will be counted.

2. Data Collection Methods

- Other (Focus groups)

Description

Dual moderator focus groups that include farmers, extensionists and researchers will be used to obtain opinions concerning the new technologies being validated. The information from the focus groups will be used to establish research priorities and improve the quality of publications.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Natural Resources and Environment

2. Brief summary about Planned Program

The principal goal 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. The program addresses key AES mission goals of supporting the Puerto Rico Department of Agriculture and the Department of Natural Resources in the management of agricultural practices by conducting the following activities: (1) development of sustainable practices for watershed protection and management (2) development of management practices for soil erosion (3) the establishment of biological indexes of contamination, and (4) sponsor forestry research, particularly in the areas of reforestation and protection of forests against fire and other threats.

A major goal of this research program is the development of sustainable practices for watershed protection and management. Water quality research will continue with work already begun on the characterization of the chemical and biological status of the most important watersheds of Puerto Rico. Currently, all reservoirs in Puerto Rico are listed as impaired due to the violation of the dissolved oxygen (DO) aquatic criteria. Our research sustains that such assessment was based on a flawed understanding of the mechanisms controlling DO dynamics tropical reservoirs. At present, this is the only ongoing research project on the island evaluating the causative agents of hypoliminion anoxia and its impact on water quality and ecosystem integrity. Results from this project will generate the so needed database and knowledge critical to the concerned government agencies in important decision making processes. A new study addressing the ecological significance of the invasive species Corbicula fluminea in two major reservoirs of Puerto Rico represents a multidisciplinary effort to establish the effect of its populations on phytoplankton community structure and cyanotoxin production at each reservoir.

Other studies related to the transport of nutrients and pollutants included in our planned program are: the measurement of nutrients and chemicals in runoff waters and nearby soils of ornamental production greenhouses and the use of low input technologies for high seedling survival of timber species in reforestation of humid tropical ecosystems with highly eroded soils. Research on biodiversity and conservation, threats to agriculture and natural ecosystems, and forestry-related issues includes: a project to protect native and endangered cacti in Puerto Rican dry forests from the invasive species Harrisia Cactus Mealybug (HCM). Activities in this project have accomplished breakthroughs in the areas of HCM population monitoring, natural controls, breeding, life cycle descriptions, and alternate hosts breadth. Another project studies the regeneration of native and introduced species in dry forest in response to multiple disturbances (fires, hurricanes, dominance by exotic tree), and reforestation alternatives for steeply sloping land incorporating high value timber species.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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			5%	
104	Protect Soil from Harmful Effects of Natural Elements			7%	
111	Conservation and Efficient Use of Water			7%	
112	Watershed Protection and Management			21%	
123	Management and Sustainability of Forest Resources			15%	
133	Pollution Prevention and Mitigation			7%	
136	Conservation of Biological Diversity			31%	
405	Drainage and Irrigation Systems and Facilities			7%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

Agriculture can be a serious pollutant source for the environment, but more reliable scientific data are needed to support these claims, to quantify the contribution of agriculture in relation to other pollution sources, and to measure the short and long term impact of agricultural operations on the environment. Accordingly, one of the priorities of this program is the characterization of the impact of agricultural activities on stream water quality, but also of point sources such as sewage, wastewater treatment plants and industrial effluents.

Unlike in the mainland US, in Puerto Rico many commercial farmers use microirrigation systems to achieve adequate yields. Microirrigation requires a high level of management to avoid plant stress and yield reductions as water use efficiency increases. Research to determine the irrigation schedule most suitable to the conditions of different crops is therefore needed and remains a priority of our program. Future work will incorporate remote research related to evapotranspiration to calculate a soil water budget. New research that evaluates plastic materials to prevent drought mortality in trees has been added to this effort.

The conservation of forest resources in Puerto Rico calls for studies on the regeneration of forests on the island, since exotic species have introduced fire into ecosystems where it was previously absent and have changed successional trajectories. Research on forest management in the dry zone of Puerto Rico will continue to study the interactions and effects of exotic species and means to protect these forests form invasive pest species. New lines in forestry research include the development of a system for planting high value timber species in steeply sloping land, wherein most of the management necessary for achieving tree survival to a self-sustaining stage is provided at planting.

New projects for this POW's time-frame include documenting the pathways of entry, impact, and management of invasive species, a major threat to the island ecosystem. In summary, the main problems to be addressed by this program are the limitations of water and land in Puerto Rico, problems associated with the transport of nutrients and pollutants, and conservation of biodiversity. Priority areas are water resources quality and management; management of nutrients and chemicals runoff, impact of aquatic weeds on agricultural water systems, conservation and biodiversity, and the management of invasive species.

Emerging research needs identified during the past three years are (by Knowledge Area codes):

101 Identification of highly productive and potential agricultural lands, using the geographical information systems and remote sensing technology

111 Development of hydrologic sustainability indicator for agricultural use

131 Inventory and appraisal of agricultural land use in Puerto Rico

136 Impact of agricultural management practices on natural ecosystems

136 Management approaches for protecting and conserving natural ecosystems from agricultural management practices

136 Management approaches for controlling environmental contamination due to bad odors, mainly from dairy and poultry production.

2. Scope of the Program

- In-State Research
- Multistate Research

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

1. Reasonable funds will be available throughout project duration.
2. Personnel with adequate skills and understating of the subject will be working in the program.
3. Support of related agencies, such as Department of Agriculture of PR, USDA, NRSC, EPA, local Environmental Quality Board and Department of Natural Resources of PR, will be available for the activities proposed and developed.
4. Watershed, soil erosion and biodiversity conservation management practices developed in the program will be adopted by producers and the general public.

2. Ultimate goal(s) of this Program

To improve the quality of the water resources of the island by decreasing the presence of chemical pesticides and nutrients' runoff, documenting the impact of point and non-point pollution sources, and recommending management practices and policy alternatives to regulating agencies; to increase the efficiency in the use of water on farms with microirrigation systems; to reduce soil erosion and improve the fertility of highly eroded soils; to increase land in forests for timber production and the protection of forests against fires and other threats; and to develop alternative agricultural and environmental management practices and policies for environmental quality.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	9.5	0.0
2012	0.0	0.0	10.0	0.0
2013	0.0	0.0	10.0	0.0
2014	0.0	0.0	10.0	0.0
2015	0.0	0.0	10.2	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

1. Conduct research on microirrigation scheduling, sustainable practices for watershed protection, detection of pollutants in streams, soil conditioners for highly eroded soils, management and sustainability of forest resources, and biodiversity and conservation in Puerto Rico
2. Publish research results in bulletins newspaper articles, popular magazines for farmers and in refereed journals for scientists.
3. Develop educational materials for stakeholders interested in the management and preservation of natural resources and agricultural sustainability
4. Disseminate research results through publications, seminars, field days, workshops, conferences, exhibitions and any other method deemed appropriate to reach our target audiences.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

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

V(G). Planned Program (Outputs)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2011	0	0	0	0
2012	0	0	0	0

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0

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

2011:0 **2012:**0 **2013:**0 **2014:**0 **2015:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2011	6	0	0
2012	6	0	0
2013	6	0	0
2014	7	0	0
2015	7	0	0

V(H). State Defined Outputs

1. Output Target

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

  2011:15 **2012:**20 **2013:**20 **2014:**20 **2015:**20

- Number of Peer Reviewed publications.

  2011:6 **2012:**6 **2013:**6 **2014:**7 **2015:**7

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

  2011:10 **2012:**10 **2013:**10 **2014:**10 **2015:**10

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

  2011:2 **2012:**2 **2013:**2 **2014:**2 **2015:**2

V(I). State Defined Outcome

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 persons that adopted practices to improve water resources.
7	Number of persons adopting invasive species management practices

Outcome # 1

1. Outcome Target

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. Outcome Type : Change in Knowledge Outcome Measure

2011:125	**2012:**150	**2013:**150	**2014:**200	**2015:**100

3. Associated Knowledge Area(s)

- 104 - Protect Soil from Harmful Effects of Natural Elements
- 111 - Conservation and Efficient Use of Water
- 112 - Watershed Protection and Management
- 123 - Management and Sustainability of Forest Resources
- 133 - Pollution Prevention and Mitigation
- 136 - Conservation of Biological Diversity

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of farmers adopting microirrigation management practices

2. Outcome Type : Change in Action Outcome Measure

2011:40	**2012:**50	**2013:**60	**2014:**70	**2015:**50

3. Associated Knowledge Area(s)

- 111 - Conservation and Efficient Use of Water

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Number of persons adopting practices that prevent biodiversity threats and losses

2. Outcome Type : Change in Action Outcome Measure

2011:60	**2012:**60	**2013:**65	**2014:**70	**2015:**100

3. Associated Knowledge Area(s)

- 123 - Management and Sustainability of Forest Resources
- 136 - Conservation of Biological Diversity

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

Number of farmers adopting methods to increase soil organic matter content

2. Outcome Type : Change in Action Outcome Measure

2011:30	**2012:**40	**2013:**50	**2014:**60	**2015:**80

3. Associated Knowledge Area(s)

- 104 - Protect Soil from Harmful Effects of Natural Elements

4. Associated Institute Type(s)

- 1862 Research

Outcome # 5

1. Outcome Target

Number of farmers reporting increased water use efficiency in their farms

2. Outcome Type : Change in Condition Outcome Measure

2011:30	**2012:**40	**2013:**50	**2014:**60	**2015:**80

3. Associated Knowledge Area(s)

- 111 - Conservation and Efficient Use of Water
- 112 - Watershed Protection and Management

4. Associated Institute Type(s)

- 1862 Research

Outcome # 6

1. Outcome Target

Number of persons that adopted practices to improve water resources.

2. Outcome Type : Change in Condition Outcome Measure

2011:30	**2012:**40	**2013:**50	**2014:**60	**2015:**80

3. Associated Knowledge Area(s)

- 111 - Conservation and Efficient Use of Water
- 112 - Watershed Protection and Management

4. Associated Institute Type(s)

- 1862 Research

Outcome # 7

1. Outcome Target

Number of persons adopting invasive species management practices

2. Outcome Type : Change in Action Outcome Measure

2011:20	**2012:**40	**2013:**60	**2014:**80	**2015:**100

3. Associated Knowledge Area(s)

- 136 - Conservation of Biological Diversity

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes

Description

Puerto Rico is frequently exposed to the impact of hurricanes and heavy rains that complicate existing problems of soil erosion and nutrient transport, particularly in the central mountain region. 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(K). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Other (stakeholders interviews)

Description

Stakeholder interviews and community sessions will be conducted throughout the seven Agricultural Experiment Stations in the island during 2010-2011. Interviews with stakeholders representing state level organizations and agencies will also be conducted to assess the needs of the island. Questionnaires will be prepared to record this input.

2. Data Collection Methods

- Other ()

Description

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Agricultural Economics, Marketing, Value Added and Community Development

2. Brief summary about Planned Program

Many of the problems faced by Puerto Rico's agricultural sector have already been partially studied under the research program carried out for decades by the integrated research and extension faculty of the Department of Agricultural Economics and Rural Sociology of the CAS. Nevertheless, the continuing challenges faced by farmers and rural communities in Puerto Rico, coupled with the reduced ability of the government to provide increased incentives or subsidies to these sectors because of a current and prospective fiscal crisis, underline the need to conduct more narrowly defined research of topics identified as vital for farming and rural community growth. Studies planned under this program include those that (1) explore new markets for our traditional products, (2) make effective use of marketing tools to exploit products' full potential, (3) explore new uses for conventional products through processing, (4) research the market for "specialty products" as a possible new alternative for our tropical crops, (5) examine efficiency problems at the level of farm management, (6) evaluate the performance of plans and programs implemented in the areas of agricultural economics, marketing, value added and community development, (7) document the status of community food systems and alternative community agricultural projects, (8) research, analyze and educate regarding agriculture and natural resource policy alternatives and consequences, and (9) model the spread and impact of invasive species in local agricultural production.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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			30%	
605	Natural Resource and Environmental Economics			5%	
607	Consumer Economics			10%	
608	Community Resource Planning and Development			10%	
610	Domestic Policy Analysis			15%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

Farming and rural community development in Puerto Rico continue to face constant challenges. The agricultural sector's contribution to the Gross Domestic Product is still less than 1%, and the island's sagging economy coupled with reduced tax revenues offer little hope that the government may increase its investment in the sector in the near future. During the last two

decades the agricultural land base of the island has experienced dramatic reductions, as part of its acreage has been converted to alternative urban development uses. In structural terms, the 2007 Census of Agriculture confirms that significant declines have also occurred since 2002 in the number and amount of land controlled by mid-sized (50-259 acres) and low sales ($1,000-$7,499) farms. Given these trends, it is reasonable to expect continued production problems in most commodities, and a decline in production efficiency. Moreover, as globalization continues to restructure local wholesale and retail distribution outlets, remaining farmers increasingly complain about fewer markets for their crops, whereas many communities lack enough employment opportunities and have limited access to quality fresh foods. Food imports of most items are also increasing, thus confirming the poor competitive position of local products vs. imported. The examination of these conditions and related trends is vitally important for the development of local agroindustries with the potential of improving community employment, and for strengthening the marketing and overall situation of our agricultural and livestock commodities. Puerto Rico needs to diversify the basis of its economic model, and a community-oriented agricultural development strategy is an option that should be incorporated into this plan. In addition, Puerto Rico needs to increase the competitiveness of its traditional agriculture and find new opportunities and niches in which it could be competitive. Recent initiatives at the PR Department of Agriculture (DA) are focusing on products that have a high probability of being economically successful, and at building tight bonds with the AES to help them in this process. This effort offers an excellent opportunity to increase the effectiveness of our research. Collaborations with the DA also include studies to determine the impact of new pests, such as the coffee berry borer, in the yield and quality of crops and in the government's crop-purchasing decisions. During this POW, priority will be given to studies of economic efficiency, marketing, new markets, community agricultural development, economic impact and modeling of invasive species dispersal, and public policy issues research and education. Both research and extension faculties will be involved in all aspects of the program. A gradual modification and reframing of this program will be conducted to meet newly established Federal research priorities.

2. Scope of the Program

- In-State Research
- Multistate Research

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

• Better knowledge of production costs, consumers' preferences and local markets will translate into marketing strategies that will allow producers to identify niches to penetrate, and support expanded commodity production.
• The institutional funding and staff needed to conduct this program will be available.
• The technology needed to increase the physical output of the selected commodities is economically available.
• An expansion in the agricultural sector production will improve the employment situation of rural communities
• A strong extension component will be developed to translate research results into effective marketing and community development strategies.

2. Ultimate goal(s) of this Program

Increase local, marketable, agricultural production and improve the quality of life and food security situation of households and communities through the development of economic efficiency and marketing studies of selected commodities, community food system profiles, promotion of community agricultural projects, identification and documentation of alternative marketing channels for farmers and community production, and through the creation of research-based educational programs that enable rural dwellers to effectively participate in public policy decisions affecting their well-being.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	2.0	0.0
2012	0.0	0.0	2.0	0.0
2013	0.0	0.0	2.0	0.0
2014	0.0	0.0	2.0	0.0
2015	0.0	0.0	2.3	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research will be conducted to determine farmers' costs of production, consumer preferences, marketing margins, and farmers' and other participants' shares in the marketing channels of selected agricultural commodities. Also, studies to identify the diverse strategies local food system stakeholders are currently using or might use to create and manage ongoing or potential change, and their information needs. Validation studies of the impact of invasive species over crops' yield, and modeling of selected invasives spread will also be done. In collaboration with Extension faculty and agents, results will be translated into recommendations for farmers, government officials, and community organizers. Publications will be prepared, and presentations to producer associations and agricultural professionals will also take place.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

Farmers, extension professionals, community leaders and organizers, producer associations, and other professionals.

V(G). Planned Program (Outputs)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0

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

2011:0 **2012:**0 **2013:**0 **2014:**0 **2015:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2011	2	0	0
2012	3	0	0
2013	2	0	0
2014	3	0	0
2015	3	0	0

V(H). State Defined Outputs

1. Output Target

- Number of refereed publications

2011:2 **2012:**3 **2013:**2 **2014:**3 **2015:**3

- Number of presentations in scientific meetings

2011:4 **2012:**4 **2013:**4 **2014:**4 **2015:**4

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

2011:4 **2012:**4 **2013:**4 **2014:**4 **2015:**4

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

2011:120 **2012:**125 **2013:**135 **2014:**140 **2015:**135

V(I). State Defined Outcome

O. No.	Outcome Name
1	Number of stakeholders gaining knowledge about new markets and marketing tools (medium term measure)
2	Number of stakeholders gaining knowledge about the economic and managerial aspects of environmental and natural resource issues

Outcome # 1

1. Outcome Target

Number of stakeholders gaining knowledge about new markets and marketing tools (medium term measure)

2. Outcome Type : Change in Knowledge Outcome Measure

2011:	**2012:**	**2013:**	**2014:**	**2015:**
375	400	425	450	425

3. Associated Knowledge Area(s)

- 601 - Economics of Agricultural Production and Farm Management
- 604 - Marketing and Distribution Practices
- 607 - Consumer Economics
- 608 - Community Resource Planning and Development

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of stakeholders gaining knowledge about the economic and managerial aspects of environmental and natural resource issues

2. Outcome Type : Change in Condition Outcome Measure

2011:	**2012:**	**2013:**	**2014:**	**2015:**
20	30	40	50	50

3. Associated Knowledge Area(s)

- 605 - Natural Resource and Environmental Economics

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

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

Description

In Puerto Rico natural disasters such as storms and heavy rains are relatively common. These situations can interfere with data collection, farmers' decisions and consumer priorities. The decisions on what to buy change dramatically after these events. If agricultural production is affected, the supply of fresh foods will be reduced. Also, Puerto Rico is undergoing a period of economic instability in which the capacity of the government to meet its current obligations and service new debt is being reduced. Consumers' attitudes and food preferences may change with the changing economic outlook. Moreover, in volatile economic situations public policy priorities may also shift to meet new demands, and this shift may compromise the ability of researchers to accomplish their long-term plans.

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

1. Evaluation Studies Planned

- Other (Focus group)

Description

In the third year of the program (2010) a focus group will be conducted with representatives of program stakeholders to evaluate progress to date and changes that may be implemented to achieve outcomes.

2. Data Collection Methods

- Other (Focus group)

Description

In the third year of the program (2010) a focus group will be conducted with representatives of program stakeholders to evaluate progress to date and changes that may be implemented to achieve outcomes.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Food Safety, Science and Technology

2. Brief summary about Planned Program

The mission of the FSST program is to promote the quality of life and economic viability of the agricultural sector by means of a continuous improvement process of current, and development of new, food and non-food products and their respective manufacturing and related processes. In so doing, the Program shall consider such aspects as food safety, nutritional value, environmental impact, education and information dissemination needs, consumer and industry support needs, technology development, transfer and adaptation, and other research needs.

Since the program's inception, our main focus has been on preparing the research facilities and acquiring the necessary human and equipment resources. Currently, that process is almost complete after investing about $1M in equipment that should be installed and operational during 2010. In terms of human resources, we filled a vacant researcher position during January 2010 and expect another faculty to return from her doctoral studies during mid 2010. Both faculty members will have 75% research/25% teaching appointments. With these developments we expect to be in a better position to compete and attract additional external funding to our program.

The new facilities have enabled us to offer more extensive services to industry in the form of trainings, analytical services, and technical support aimed at strengthening their products and processes. In the long term, we expect our program to play an important role in the growth and diversification of local industry, and consequently, in the local economy. To meet this goal, we also plan to establish collaboration agreements with industry.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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			20%	
502	New and Improved Food Products			20%	
503	Quality Maintenance in Storing and Marketing Food Products			30%	
504	Home and Commercial Food Service			20%	
701	Nutrient Composition of Food			10%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

Nourishment is essential for life to exist. It is the role of the agro-industry to ensure a safe and sufficient supply of nutritious food at an affordable price, while minimizing the impact on the environment. Yet, accomplishing such a role

requires agro-industry to negotiate its own objectives along with consumer demands, governmental regulations and market push towards the implementation of quality management systems.

On the government side, federal agencies such as the Food and Drug Administration (FDA), and the United States Department of Agriculture (USDA) partner with local agencies (i.e., Puerto Rico's Department of Health and Puerto Rico's Department of Agriculture) to oversee the safety and wholesomeness of the produced goods. They also impose restrictions on package labeling and information, handling and storage conditions, construction and design of manufacturing and service facilities, sanitation, and general production operations (i.e., GAP, GMP).

In contrast with the need to implement controls and systems, that necessarily increase costs, there are consumer pressures for an affordable and nutritious supply of goods. Furthermore, current consumer trends in the food industry show, for example, the need for such supply to have a wide array of gourmet flavors mixed with convenient sizes, and added functionality. During a recent program meeting (i.e., January 2010) the program priorities were revised and slightly modified to read as follows:

· Market diversification through the development of products and processes to add value to agricultural goods in a way that ensures their safety and nutritional value to the consumers.
· Market strengthening through the development or adaptation of postharvest and packaging technology and practices to maintain the safety and quality of agricultural goods in the supply chain.
· Definition or evaluation of quality parameters for fresh and processed goods, including safety and nutritional value.
· Characterization and reutilization of harvest, slaughter or food processing wastes, residues and effluents for the development of value added goods.

2. Scope of the Program

- In-State Research

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

· The high cost of manual labor on the island, compared to our competitors in the Caribbean and Latin America, limits the fresh market potential of our agricultural system. As a result, Puerto Rico has an underutilized agricultural production potential that can become productive with relative ease.
· In order for agriculture to become a more economically attractive alternative, Puerto Rico needs to move farmers away from production for the fresh market and onto a community-oriented agricultural development strategy to deliver value added products.
· Should new feasible, value added product alternatives become available, Puerto Rico's farmer cooperatives and industry will embrace the new markets and exploit them.
· The establishment and habilitation of CITAI (Center for Innovation and Agro industrial Technology), including allocation of necessary funds and human resources, will position the Program to act as leader in the development and adaptation of technology to improve production processes of value added agricultural products.
· External funding will be obtained to support research and related activities of the Program.

2. Ultimate goal(s) of this Program

Promote the viability of the agro-industrial sector and society's quality of life, by continuous process-improvement of food and non-food products, current or new, and their respective manufacturing processes. This includes such aspects like food safety throughout the production and supply chain, nutritional value, packaging, transport, and other related factors.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2011	0.0	0.0	2.0	0.0
2012	0.0	0.0	2.5	0.0
2013	0.0	0.0	2.5	0.0
2014	0.0	0.0	2.8	0.0
2015	0.0	0.0	2.8	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

· Presentations, journal articles, Extension Service publications, and other literature contributions that make research results available to users, and/or establish guidelines or recommendations for process improvement or compliance with government regulations.

· Seminars, short courses and workshops on various topics with open registration to industry and particular individuals.

· Projects' collaborations with industry to research specific issues affecting their product or processes.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

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

V(G). Planned Program (Outputs)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2011	0	0	0	0
2012	0	0	0	0

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0

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

2011:0 **2012:**0 **2013:**0 **2014:**0 **2015:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2011	3	0	0
2012	4	0	0
2013	5	0	0
2014	5	0	0
2015	7	0	0

V(H). State Defined Outputs

1. Output Target

- Number of Courses, seminars and workshops offered on the topics covered by the Program

2011:3 **2012:**4 **2013:**4 **2014:**8 **2015:**8

- Number of projects or industry collaboration agreements established

2011:2 **2012:**2 **2013:**4 **2014:**4 **2015:**4

V(I). State Defined Outcome

O. No.	Outcome Name
1	Total Number of Enterprises Impacted by the Program
2	Food Manufacturing Exports in million dollars
3	Food Manufacturing Imports in million dollars

Outcome # 1

1. Outcome Target

Total Number of Enterprises Impacted by the Program

2. Outcome Type : Change in Knowledge Outcome Measure

2011:35	**2012:**40	**2013:**45	**2014:**50	**2015:**60

3. Associated Knowledge Area(s)

- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 503 - Quality Maintenance in Storing and Marketing Food Products
- 504 - Home and Commercial Food Service
- 701 - Nutrient Composition of Food

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Food Manufacturing Exports in million dollars

2. Outcome Type : Change in Action Outcome Measure

2011:4981	**2012:**5000	**2013:**5400	**2014:**5400	**2015:**5500

3. Associated Knowledge Area(s)

- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 503 - Quality Maintenance in Storing and Marketing Food Products
- 701 - Nutrient Composition of Food

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Food Manufacturing Imports in million dollars

2. Outcome Type : Change in Condition Outcome Measure

2011:3000	**2012:**3000	**2013:**3000	**2014:**3000	**2015:**3000

3. Associated Knowledge Area(s)

- 501 - New and Improved Food Processing Technologies

- 502 - New and Improved Food Products
- 503 - Quality Maintenance in Storing and Marketing Food Products
- 504 - Home and Commercial Food Service
- 701 - Nutrient Composition of Food

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Economy
- Public Policy changes
- Government Regulations
- Competing Programmatic Challenges

Description

Economy &ndash Puerto Rico is currently suffering an economic recession. Though it is expected for the economy to pick up, while the recession prevails, the amount of funding available to invest in research or new ventures will be limited. It was recently revealed that the University budget has a deficit of over 100 million. Actions taken to palliate this deficit have affected funding available for travel, and the acquisition of materials needed to seek external funding and establish industry collaborations.

Public policy changes &ndash The agricultural sector is highly susceptible to changes in public policy as dictated by the local Department of Agriculture. New government strategies are attempting to strengthen the links between the Department of Agriculture and the College of Agricultural Sciences of the University of Puerto Rico.

Government regulations &ndash Governmental regulations can affect the import and export of agricultural commodities, thus affecting the local farmers' ability to produce goods at a competitive market price. Regulations can also affect the establishment and expansion of incentives for new and existing industries.

Competing programmatic challenges &ndash Collaborating faculty is not solely dedicated to this program. They must address other issues as required by their respective departments. Thus, we have a pool of researchers periodically changing.

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

1. Evaluation Studies Planned

- Other (Semi-annual meetings)

Description

Semiannual meetings are conducted to track Program performance and to agree on the mission, objectives, and strategies of the Program (previously drafted on the basis of informal input). Meeting participants will include the program coordinator, commodity group leaders, Extension Service agents, active and inactive program researchers, and a representative of the Agricultural Experiment Station administration. The meeting will compare output performance against projected goals and will determine whether specific actions are required. Also, feedback gathered on the needs of stakeholders (i.e., commodity groups) will be reviewed in order to identify changes in research priorities and needed updates on this plan of work.

2. Data Collection Methods

Description

{NO DATA ENTERED}