2014 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 (PRAES) 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 PRAES coordinates its academic activities with the teaching Faculty of Agricultural Sciences and the Agricultural Extension Service, and incorporates into its research program the faculty of these other two institutional units of the CAS. Although this Plan of Work (POW) is being separately submitted by the PRAES, we are already planning for a joint submission next year with the Puerto Rico Agricultural Extension Service.

This POW incorporates input received 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 PRAES staff. This input helps to identify major constraints to agricultural production and to establish priorities that should be targeted by our research programs.

Following NIFA's guidance, all planned programs were reviewed in 2011 and recontextualized to address both local goals and the five national priorities of Global Food Security and Hunger, Climate Change, Sustainable Energy, Childhood Obesity and Food Safety. The names of our planned programs were slightly modified and hyphened to include the national priority addressed. Although NIFA no longer requires programmatic alignment with national priorities, we opted to keep the revised name since it still reflects the principal long term goal of each program. This POW update also follows NIFA recent guidelines on how to report the FTEs devoted to our programs. As suggested, in the overview section we are reporting total SY/PY FTEs irrespective of their funding source, while under the individual planned programs we are reporting only those FTEs funded through Hatch and Hatch Multistate funding lines.

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 (DA) data show positive growth in several subsectors such as 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. Through its research and education programs, the College Of Agricultural Sciences of the University Of Puerto Rico has been an important contributor to the development of enterprises with 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. To regain and maintain Puerto Rico's agriculture competitive position in the globalized economy, research must be directed toward the analysis and solution of problems stalling production, and to the search of alternative uses and markets for our products, and for new, higher-profitability niche-market commodities.

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 a 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 that 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.

Among these, crop protection studies continue to figure prominently in the profile of projects approved last year. Strategies advanced in proposals include the production of disease-free planting material, research on alternative control methods (including chemical but emphasizing on biological control), molecular characterization of specimens and improved diagnostic technologies, and partnering with local Department of Agriculture and Extension agents to educate stakeholders on management alternatives.

Being a centennial institution, the gradual upgrade of aging research facilities and supporting program infrastructure has become another investment priority, more so in view of the continued need to attract external funding for our programs and the increasingly competitive nature of funding requests. In a continued partnership with APHIS-PPQ, PRAES recently started the second phase of a reconversion of formerly underutilized laboratories and greenhouses into a certified quarantine center for invasive species research and management approaches. The renovated facilities, being remodeled with more greenhouse-efficient construction materials and state of the art cooling systems, will enable the center to develop biological control technologies for invasive pests entering or threatening the USA through the Caribbean pathway. In the Isabela and Corozal substations laboratory facilities are also being renovated to establish a formal micropropagation program with the capacity to meet the needs of the field regarding virus, fungus, and bacteria-free planting materials. Moreover, protected structures are being built at the Adjuntas, Corozal and Isabela substations to produce seed and propagation materials for cases such as the citrus industry facing Citrus Greening, in which certified disease-free materials are needed.

Another recently constructed facility will soon house PRAES Museum of Entomology and Tropical Biodiversity. Offering taxonomic support to both our Natural Resources and Environment and Integrated Management of New and Emerging Pests and Disease programs, the new facility will house an insect collection dating back to 1910, and will help with our efforts to educate the public on our insect fauna and the threat of invasive species.

Research and extension work on the best management practices for crops and livestock production systems is another major continuing direction of PRAES initiatives related to food security. Through special donations made by the local Department of Agriculture we have been able to acquire needed equipment for our dairy facilities in Lajas and to invest in irrigation-related infrastructure for several substations. We expect these investments to strengthen our capacity to conduct studies on economically viable, sustainable production systems that incorporate alternative management practices. Research also continues on the development of high value specialty crops, such as organic crops, specialty coffee and exotic fruits, and on value adding processes, technologies and marketing arrangements.

Continuing concern about threats to our environment and natural resources remains the principal thrust behind our research program in these areas. New projects include studies about the status of endangered species in our karst region forests, diseases vectors affecting local palms, damage to native cactus species caused by the Harrisia Cactus Mealybug, and nutrient levels associated with ecological thresholds of impairment in the water reservoirs of Puerto Rico.

Finally, several new projects have been developed by our agricultural library staff to facilitate the transfer of relevant information to our stakeholders. A centralized digital information Internet portal for all agriculture-related information produced by the Puerto Rico Department of Agriculture (DA) and the PRAES is now under construction. When fully operational, the new Digital Agricultural Information Resource Center of Puerto Rico will provide access to available scientific resources related to the island's agriculture, and facilitate access to other services offered by the DA. With external funding provided by the Rural Development Administration we are also in the process of acquiring new hardware and software resources to provide library service and support to researchers at each of the six substations administered by PRAES around the island, and to the public in nearby rural communities.

This Plan of Work revision updates our collective proposals on how to improve the resiliency of Puerto Rico's production system in regard to the predicted effects of climate change while contributing to the common goals of increasing local and regional food security, food safety, and sustainable energy. Our **Agricultural Economics, Marketing and Community Development program** portrays how the island's higher costs of production and lower productivity, compared to that of neighboring producers of tropical crops, have propitiated the massive penetration of lower cost agricultural goods from elsewhere and thus lowered local market prices to a level that even gradual productivity increases are no longer able to counteract globalization's lower market prices. Researchers suggest that substantial efforts are needed to innovate, control costs, find new market niches with the capacity of spurring employment in rural areas, and to make better use of Puerto Rico's natural resources, to improve the economic and social sustainability of agriculture on the island. Participants in the **Food Safety, Science, Technology and Childhood Obesity** (FOSSTCO) program concur with this assessment and suggest that in order for agriculture to become a more economically attractive alternative, research should be geared toward the delivery of value added products. By focusing on adding value to Puerto Rico's principal crops, on processing, and on improving the safety of our food supply, this planned program also hopes to minimize post-harvest losses, and to guarantee a more continuous supply of goods in the case of extreme meteorological events, one of the predicted outcomes of climate change in the region. At present we have no projects dealing with childhood obesity in our profile, but this may change in the future. Any activity related to this area will be reported under the FOSSTCO program.

As for our **Meat and Milk Production** program, local analysts stress the need for increasing the efficiency

and productivity of livestock industries, both from the point of view of food security and of making a positive contribution to the mitigation of climate change impacts. Although our institution has long advocated on reducing reliance on concentrate feeds through production and utilization of high quality forages, this was only possible by intensive application of inorganic fertilizers. The current high price of fertilizers merits a modification of this approach by focusing on agronomic methods of a more organic kind, such as crop rotations including annual legume green manures. In order to achieve the industry's goals it is imperative that better husbandry practices be implemented. Improved outreach methods and follow-up studies to verify adoption of recommended management practices are suggested. Similarly, researchers participating in the **Plant Genetic Resources, Breeding and Production Systems** program underscore the continuous role played by our institution towards the viability of local farming and food security through the conservation of plant genetic resources, variety improvement by plant breeders, development of better management practices for all crops, and collaboration in the delivery of improved seeds to farmers. The PRAES has unique research expertise with many tropical crops that are potentially important for increasing food production in Latin America and Africa, expertise that will therefore contribute to national efforts addressing the Global Food Security and Hunger priority.

Climate change could have a significant impact in our current **Integrated Management of New and Emerging Pests and Diseases program**. To respond to the increases in diseases, pests and weeds associated with warmer temperatures and changed rainfall and drought patterns, among other factors, collaborative research and surveillance efforts of our current crops and farming systems must continue. Already significant progress has been made with the implementation of molecular methods for bacterial, viral and fungal pathogen diagnosis. Priority will continue to be given to research addressing alternative control practices for recently identified diseases and pests, to the development of disease resistant cultivars, to the use of reduced risk practices for vector and pathogen management, and to the selection of efficient biocontrol agents for major pests and diseases. In addition, we will continue to set up quarantine facilities that can be used in the development of biological control technologies, and to increase surveillance for the appearance of diseases for which known vectors are already present in the island. Finally, we will continue strengthening present collaborations with the Extension Service.

Researchers in our **Natural Resources and Environment** program are fully aware of the challenges posed by climate change in terms of an accelerated pace of biodiversity loss, land degradation, water availability and through the spread of alien invasive species. The core of our program will thus remain focused on water-related issues (watershed protection, management, and water quality), soil management, and biodiversity research--particularly in forestry and on the biology and spread of invasive species. In addition, the increase in fertilizer costs continues to spur interest on the development of organic and other sustainable practices that could potentially improve soil quality and crop yield on tropical acid soils. According to stakeholders, the inventory and appraisal of current and potential land uses, and the identification of soil types and their suitability for specific uses are among the emergent research needs that should be targeted by this program.

Finally, the **Renewable Energy Alternatives for Small Islands** remains our newest and smallest research program**.** In Puerto Rico the high cost of energy is one of the factors increasing production costs for agroindustries, and affecting their competitive position in the market. Accordingly, the long term goal of this program is to achieve greater energy efficiency and reduce the operating costs of farming and agroindustrial operations on the island by diversifying and improving the design of the energy alternatives currently available locally, by assessing the cost-effectiveness of these alternatives and by disseminating this information to stakeholders. At present photovoltaic technology remains the renewable energy resource more readily available for use by the island's agroindustries, but research efforts are also geared towards optimizing energy generation alternatives from agricultural wastes.

Although some programs have been intending to devise and revise indicators that could serve as measures of the programs' progress toward its goals, this has not been an easy task and most programs

are still pondering how to collect the needed data. Researchers are aware that in order to obtain reliable measures and data on actual adoption of recommended practices and technologies, there must be a closer collaboration with Extension personnel. Perhaps working towards a joint POW submission next year will improve the data availability and reliability of our indicators.

Last year, following NIFA guidelines, all of our programs incorporated an evaluation component to their proposed plan of work. Results of these evaluation studies are not yet available but program coordinators are already conducting or planning for the celebration of most of the proposed activities during early Fall. Nevertheless, coordinators are also aware that to implement a more thorough evaluation process the administration will need to assign resources to the development and staffing of these components, and will have to balance the need to evaluate with the other pressing needs put forward by stakeholders and by the faculty participating in the program.

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

Year	Extension		Research	
	1862	1890	1862	1890
2014	0.0	0.0	64.5	0.0
2015	0.0	0.0	63.7	0.0
2016	0.0	0.0	63.2	0.0
2017	0.0	0.0	63.0	0.0
2018	0.0	0.0	62.5	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 last year's POW update. We continue to allocate part of our Hatch-funded research to competitive project grants selected on the basis of an annual call for proposals with the year's revised priorities. 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 PRAES 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 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 PRAES 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 PRAES 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 Plan of Work reflects our collective proposals on how to improve the resiliency of Puerto Rico's production system in regard to the predicted effects of climate change, while contributing to the common goals of increasing local and global food security, food safety, and sustainable energy. These national goals also represent the principal issues of strategic importance for Puerto Rico, and during the past two years particular attention has been devoted to tailoring our programs to explicitly address these long-term concerns.

In addition, 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 PRAES research program. Because the PRAES 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 is reviewed by each program coordinator and the CAS administration, and final recommendations are 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 PRAES goals continues to be monitored by the indicators included in this POW and discussed in the yearly program and commodity meetings. Additional program meetings are periodically held,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 are being distributed through a yearly request for proposals (RFP) that 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 State(s)?

Puerto Rico is almost totally Hispanic, with 45% of its 2010 population living below the federally defined poverty line. In addition, joblessness is much higher than in any of the 50 states, a condition only made worse by the current economic recession. 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's planned programs' efforts towards the enhancement of natural resources and towards the analysis and solution of problems affecting agriculture, with the ultimate goal of increasing the competitive production of our commodities, raise the employment level of the population, and improve the food security status of island residents, 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, women in farming, 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 several projects are now underway to promote environmentally friendly organic management practices, and to develop an organic seed production program in the island. Collaboration by researchers in extension initiatives related to public policy issues and in a multi-state Southern Extension and Research Activity on this topic is also underway. In the past few years, investments in upgrading research facilities and land infrastructure in substations around the island have been made, also improving their internet access and computer hardware and software resources. These new digital resources will soon be available to the public in the rural communities where these substations are located. 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 in order to make the 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.

Last year, following NIFA guidelines, each planned program incorporated a more formal evaluation section. Most programs proposed that a written report be prepared of the evaluation outcomes to be shared at program meetings and with PRAES administrators, and used to update program priorities and overall implementation. 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

An effective coordination of research, extension and academic activities is needed to achieve intermediate results and long-term impacts. Although there has been an historic connection between these three activities, before the current POW's implementation researchers did not report progress and impact of research beyond the traditional publications, theses, seminars and field days described in annual reports. Similarly, whereas extension education programs were often based on research results, actual participation by extensionists in research activities was limited. With the adoption of the current POW system we have made a conscious effort to expand collaborations with Extension, particularly in the adaptation of research results to local production systems but also in the implementation of other aspects of our programs. 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 have been encouraging more meetings and coordinated educational activities with research and extension faculty participation. Our Integrated Management of New and Emerging Pests program and Extension's Crop Protection Program have already been closely cooperating in the fulfillment of their shared goals. Also, since last year, the leadership of several of our commodity-focused research programs was transferred to faculty with Extension appointments, a step taken to improve the communication of research results to our audiences and better access to stakeholders' input for our programs. In addition, discussions are already under way to consolidate PRAES and Extension's Plans of Work and Annual Reports into only one document; a measure that we expect will translate into further collaboration between both faculties, and increased effectiveness of our shared programs.

IV. Stakeholder Input

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

- Use of media to announce public meetings and listening sessions
- 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 PRAES research programs. Stakeholder input is also considered during the establishment of research priorities. First, the PRAES 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 other 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. These meetings are also announced in the PRAES web page. 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
- Open Listening Sessions
- 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. Since all meetings are announced on the PRAES web page, interested public not targeted by these invitations also show up at the meetings.

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
- Meeting with the general public (open meeting advertised to all)

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

Global Food Security and Hunger - Milk and Meat Production Systems

2. Brief summary about Planned Program

Research and extension efforts under this program seek to improve the biological efficiency of livestock production and economic returns to the producers. Impact at the farm level relies on education and training methods to encourage adoption of recommended management practices of either a traditional or innovative nature. If successfully adopted, these endeavors should contribute to increased production of meat and milk and dairy products of high quality offered to the consuming public at accessible prices, thus fostering food security. Our largest research effort will involve agronomic aspects of forage crop culture, with emphasis on cost efficient and environmentally friendly fertilization procedures; and utilization of highly nutritious forages in the form of grazed herbage, hay and silage to substitute in part for imported concentrates and reduce feed costs. Other important areas of research to be addressed include: improvement of beef cattle genotypes; reproductive management, alleviation of heat stress and mastitis prevention in dairy cattle; control of internal parasites and feeding of small ruminants; and quality assessment of animal products before harvest.

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			12%	
301	Reproductive Performance of Animals			12%	
302	Nutrient Utilization in Animals			12%	
303	Genetic Improvement of Animals			12%	
306	Environmental Stress in Animals			10%	
308	Improved Animal Products (Before Harvest)			12%	
311	Animal Diseases			10%	
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

Dairying is the leading agricultural enterprise in Puerto Rico and contributes approximately one-fourth of the gross on farm income of the island. However, the situation of this industry has turned markedly more difficult during the past 12 months due to steep increases in the cost of imported concentrate feeds, which have resulted in part from unaccustomed drought and lowered grain production in the USA heartland. Our institution has long advocated reducing reliance on concentrate feeds through production and utilization of high-quality forages, but in the past this was achievable by using high applications of synthetic fertilizers. At present fertilizer prices are also extremely high, which requires a new approach. Agronomic methods of a more organic kind, such as crop rotations including annual legume green manures, should now be top priority research and extension goals. This type of research is equally pertinent to the beef cattle and small ruminant enterprises, which also cannot afford heavy use of concentrate feeds. Efforts toward achieving improved efficiency in other aspects of livestock production, such as genetically improved animals, high rates of reproductive success and animal health and comfort, are also needed to contribute to reasonable economic returns to producers, while also maintaining an adequate supply of high-quality animal products for human consumption.

2. Scope of the Program

- In-State Extension
- In-State Research

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

1. Assumptions made for the Program

1. Research and extension personnel under this program, who are members of the Animal Industry and Crops and Agroenvironmental Sciences Departments, will possess the necessary academic expertise and professional training to achieve the scientific and practical goals set forth.
2. Funding from all sources, including federal, commonwealth and private, will gradually increase in constant dollars over the next 5 years as economic conditions and public finances return to a more normal state.
3. Physical facilities, including various types of laboratories and animal resources, of the institution will continue to develop and prove adequate to meet the needs of the research program.
4. The extension personnel working under this program area will be fortified by filling positions now vacant.
5. The dairy industry of the island will mostly not employ a high degree of animal confinement but make greater use of improved grazing and supplemental feeding of highly nutritious forages such as sorghum silage.
6. The specialized beef cattle industry will be compelled to make use of male dairy calves as a source of feeder animals and must strive to produce grass-fed beef, with a composition more conducive to good health of the human consumer than feed lot beef that will command a higher sales price.
7. Small ruminant production, including goat's milk and cheese, will gradually increase in importance and make use of novel forage resources.
8. The swine industry of Puerto Rico can be expected to stay due to the ethnic food habits of the local people, but is unlikely to increase much in volume of production.

2. Ultimate goal(s) of this Program

Research and extension efforts undertaken in this Program seek to promote food security in Puerto Rico by increasing the volume and improving the quality of locally produced meat and milk and their respective derived products at prices accessible to all local consumers. Equally important is to contribute to improved economic returns obtained by livestock producers and to the agricultural income of the island. Another goal of critical long-term importance is to help protect the remaining agricultural lands of the island by keeping them profitably engaged in sustainable animal production and not sold for conversion to non-agricultural uses.

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
2014	0.0	0.0	4.0	0.0
2015	0.0	0.0	3.7	0.0
2016	0.0	0.0	3.7	0.0

Year	Extension		Research	
	1862	1890	1862	1890
2017	0.0	0.0	3.5	0.0
2018	0.0	0.0	3.5	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

1. Maintain communication with livestock producers and their organizations to receive their input regarding problems that they face that may benefit from research.
2. Submit experimental results in terms of animal responses to economic evaluation and possible inclusion in the list of practices recommended for adoption on producers' farms.
3. Organize field days and training sessions to interest livestock producers in adopting recommended management practices on their farms.
4. Continue to use traditional extension methods such as farm visits, consultation with producers by telephone or electronic mail, participation in radio programs of agricultural interest, and publication of materials like the educational newsletter entitled "La Res Informativa", for the benefit of the local beef cattle industry.
5. Establish a mutually beneficial working relationship with the new leadership of the Department of Agriculture of Puerto Rico in support of its initiatives.
6. Attend and present research results at relevant scientific societies at the local and international levels.
7. Prepare research results for submission to peer reviewed scientific journals.

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. Producers, and their employees, of the following types of farm animals and related products: milk cows and replacement dairy heifers, bovines for meat, goats for milk, sheep and goats for meat, swine and rabbits for meat, poultry for meat and eggs, and forages for sale.
2. Private sector entrepreneurs and their employees working as sales or service people in related businesses, including feed mills, manufacturers of feed additives or supplements, providers of semen or embryo transfer services, stores selling agricultural and veterinary supplies and equipment, sellers of agricultural machinery and mechanical milking equipment.
3. Self-employed professional consultants
4. Officials and policy makers of the USDA and PR Department of Agriculture
5. Personnel of the Farm Credit Service and other pertinent financial institutions
6. Agricultural Extension Service agents
7. Teaching faculty of the College of Agricultural Sciences at Mayagüez and of the Department of

Agriculture Sciences at Utuado.

8. Interested graduate and undergraduate university students
9. High School students of Vocational Agriculture or potential applicants for admission to university level studies in agriculture.
10. Mass media and the general public

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of meetings held with stakeholders to discuss the situation of each relevant industry and corresponding research priorities
- Number of popular (non-refereed) publications to report research results and other pertinent information for the benefit of producers and other interested parties
- Number of field days, training sessions and other types of educational services provided for producers
- Number of publications in refereed scientific journals.

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Number of producers participating in field days or training sessions who express willingness to adopt demonstrated management practices on their farms
2	Yearly percentage increase or decrease of on farm income from sale of livestock and related products in Puerto Rico

Outcome # 1

1. Outcome Target

Number of producers participating in field days or training sessions who express willingness to adopt demonstrated management practices on their farms

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 205 - Plant Management Systems
- 301 - Reproductive Performance of Animals
- 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

Outcome # 2

1. Outcome Target

Yearly percentage increase or decrease of on farm income from sale of livestock and related products in Puerto Rico

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 301 - Reproductive Performance of Animals
- 302 - Nutrient Utilization in Animals
- 303 - Genetic Improvement of 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
- Other (lack of interest in farming, etc)

Description

Natural Disasters (Adverse weather conditions)

Rainfall distribution is all-important to most of the livestock industries of Puerto Rico that depend on the non-irrigated lands devoted to grazed and mechanically harvested forages. Both extremes, drought and flooding, can have negative effects on production of the forages that animal feeding depends on. Furthermore, a direct hit by a hurricane, which could cause massive losses, is an annual possibility from July to November.

General Economic Situation

Commercial-scale production of foods of animal origin will never be cheap in Puerto Rico. Most of the material inputs used in livestock production are imported and expensive. Also, costs of land and labor are much higher than in other exporting countries that compete with local producers. Protection against such competition is beyond local control. Adding further difficulty to the picture is the reduction in purchasing power experienced by local consumers during recent years due to loss of jobs, especially in the manufacturing sector, and thus high levels of unemployment and underemployment among people of working age; and modest pensions that do not include adjustments for cost of living increases, received by many retired people.

Appropriation Changes

A new Commonwealth government took office in January 2013 and immediately faced a situation of daunting public debt and shortage of operating funds. Further complicating the situation is the so-called "fiscal cliff" being debated in the US Congress, the upshot of which might be a reduction in federal funds for Puerto Rico, possibly even in the remainder of the present fiscal year. Reduced allocations may be in store for the Dept. of Agriculture of PR, which would limit still further the funds available to pay incentives to producers; and for UPR, especially the Experiment Station and Extension Service, which would be detrimental to research and extension endeavors under this program.

Other

Lack of interest in farming- The average age of farmers in Puerto Rico has long been rising and now stands at a level that requires serious attention. Unless more young people can be attracted to work in productive agriculture there will be too few livestock producers in the future.

Agricultural lands- The extravagant disregard for the future that led to the loss of more than half of the land suitable for agriculture in Puerto Rico over the past six decades has left the island in a precarious situation. If further losses are not held to a minimum, within a few more decades there will be so little agricultural land left as to make food security a lost cause.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

A record of attendance will be kept at all educational and training events organized for producers and other interested parties. In all cases the attendees will be requested to evaluate the usefulness of the

subject matter offered and the quality of the presentation. In those cases in which recommended management practices are demonstrated, participating producers will be requested to fill out a short questionnaire in which they will choose among four options as to their willingness to employ the practice in question on their farms; (A) none, (b) minimum, (C) moderate, and (D) considerable. This information will be used by Extension Service personnel in follow-up efforts to further encourage adoption of the practices that the producers indicated interest in. Cases of successful adoption on producers' farms will be emphasized in future educational activities in the hope of convincing additional producers to do the same.

The following list outlines some of the key components of the evaluation plan for this program:

Who will participate in the evaluation (target audience)? Producers participating in the educational and training events organized under this program.
Who will conduct the evaluation? Current research administrators, program coordinators or commodity leaders.
Method: Short questionnaire.
When: Beginning with activities conducted under the 2013 POW.
Focus of questions: Willingness to adopt demonstrated management practices in producers' operations and ways to improve our communication strategies.
Expected results: Extension Service personnel will use this information to further encourage interested producers to implement the management practices in question and also to plan additional outreach activities that may eventually convince reticent producers to alter their attitude toward RMP, a change that could benefit them. We also expect to identify ways to improve the program's implementation and also ways in which information is to be shared.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change - Integrated Management of New and Emerging Pest and Diseases

2. Brief summary about Planned Program

The increasing capacity to diagnose diseases and pests that affect agricultural crops in Puerto Rico has improved the speed and accuracy with which pathogens and disease vectors are identified. An emergent Tospovirus-inducing disease in tomatoes was identified in the southwest of the island. Control efforts will be directed toward the use of vector management practices; outreach activities will be organized to promote the use of ecologically based control practices. The incidence of citrus greening in orchards in the west part of the island has increased. Citrus nurseries are tested for Citrus Greening, Citrus Tristeza Virus, and Citrus Variegated Chlorosis, and plants testing positive are eliminated to prevent disease transmission through vegetative material. Our goal is to produce disease-free citrus vegetative material by using insect-proof screening in nurseries. Also in plans are initiatives to improve fertilization and psyllid control in orchards. Using light and scanning electron microscopy, powdery mildews caused by Erysiphe heraclei, E.peruviana, E.quericola, Podosphaera fusca, and P. xanthii were identified. New reports for Puerto Rico were published. An open access online database containing information pertaining to powdery mildews of Puerto Rico was created. This database will allow for accurate species identification and enforcement of quarantine regulations aiming at stopping the introduction of new species of pathogens into the island. Vegetables continue to be affected by viral diseases on the southern coast of Puerto Rico. Potyviridae were detected all over the island and in Culebra and Vieques. Molecular diagnostics of Squash Vein Yellowing Virus (SqVYV) was confirmed as affecting local watermelon.

The Center of Excellence for Invasive Species Prevention and Quarantine Laboratory is PRAES most recent key initiative. Still under development through a cooperative agreement with APHIS-PPQ, it is geared towards improving our local and national preparedness for managing invasive pests. At present, the Center is focusing on the Tomato Leaf Miner (Tuta absoluta) in Panama, exotic fruit flies (Anastrepha species), and invasive pathogens and their vectors, such as Brevipalpus spp. (Acari: Tenuipalpidae) vector mites. Field work with Harrisia Cactus Mealybug (Hypogeococcus pungens) established in Guanica, Cabo Rojo and Punta Petrona Natural Reserves will continue. Although newly infested sites were found at the Cabo Rojo Wildlife Reserve, natural enemies have also been identified. The introduction and the establishment of several parasitoids for the biocontrol of the coffee berry borer Hypothenemus hampei has continued. The parasitoids Phymastichus coffea and Cephalonomia stephanoderis will be mass reared and then established in coffee plantations in three ecological areas in Puerto Rico. The work with invasive species has been fruitful and current efforts to slow down or prevent the spread of new invasive species will continue.

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
211	Insects, Mites, and Other Arthropods Affecting Plants			16%	
212	Pathogens and Nematodes Affecting Plants			23%	
215	Biological Control of Pests Affecting Plants			32%	
216	Integrated Pest Management Systems			29%	
	Total			100%	

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

1. Situation and priorities

The long-term development of the IPM program of the Puerto Rico Agricultural Experiment Station (PRAES) is intended to generate results which will ameliorate the impact of pests and diseases. Priorities will continue addressing five areas: (1) improvement of methods for the identification of new and emergent pests and diseases; (2) development of disease resistant cultivars; (3) use of reduced risk practices for vector and pathogen management; (4) selection of biological control agents for major pests and diseases; and (5) appropriate development of technology dissemination methods and effective implementation of sustainable management practices for new pest and disease threats.

To achieve these goals we will continue with better methods of diseases' diagnostic and pest detection and identification by using molecular techniques. Disease and pest resistance are key components for effective integrated management practices. Common bean breeding lines developed by the CRSP Pulses/USAID project will be screened for resistance to major diseases. Bruchid resistance should improve the quality of common bean seed production on the island. The search for cultivars with disease tolerance will be accomplished through collaboration with breeding programs scientists. The use of new communication methods for technology dissemination, including the use of webinars and webpages, will be incorporated into the program scope. We will continue with the implementation of best management practices for citrus greening in orchards, including psyllid control using new insecticides to avoid development of psyllid resistance. Production of disease-free citrus plants in insect-screened greenhouses was implemented at PRAES. The use of fertilization practices to extend the production years of citrus orchards will be validated. Virus-induced crop failures are still occurring and costly insecticide applications have resulted in economic losses for farmers. Research in the Potyviridae has become important and PRAES will continue the search for cultivars resistant to the different viruses that affect vegetables and other crops. The decreased use of insecticides, and the validation of the use of reflective

plastic and barrier crops to manage the vector populations, have become a priority. The search for new environmentally safe pesticides, and the dissemination of IPM practices to stakeholders through the Extension Service needs to be strengthened.

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

1. Budget cuts will not affect the availability of resources at the University to conduct research properly.
2. The scientists needed to develop this program are available.
3. Personnel with adequate skills and knowledge of the research methods will be assigned to collaborate with the scientists.
4. Agricultural Experiment Substations will be available to conduct research in different crops.
5. The input of partners from Extension Service, USDA/APHIS, Puerto Rico's Department of Agriculture and producer groups will be available.
6. IMP practices for the design of Pest Management Strategic Plans in important crops will be available.
7. IMP practices suggested in the pest management strategic plans will be adopted by the producers of the island.

2. Ultimate goal(s) of this Program

• To decrease crop losses due to new and emerging pests and diseases in order to decrease the damage inflicted upon the environment and health by unsuitable management practices.

• To intensify pest surveillance in order to prevent disease and pest outbreaks.
• To contribute with the accurate identification of pests and diseases and train First Detectors for the diagnosis of exotic diseases.
• To identify options and plans to address gaps in our knowledge regarding the impact of climate change on new pests, diseases, weed and disease prevention and on management options.
• 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
2014	0.0	0.0	2.7	0.0
2015	0.0	0.0	3.0	0.0
2016	0.0	0.0	3.0	0.0
2017	0.0	0.0	3.2	0.0
2018	0.0	0.0	3.5	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

- Develop PCR-based detection with varying levels of specificity for viruses, fungi, and bacteria.
- Develop biological control technologies for invasive pests.
- Develop improved methods to control vectors of pathogens.
- 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 and establishment of collaborative partnerships wiith stakeholders
- Develop effective disease and pest management strategies compatible with a sustainable food production system in Puerto Rico.
- 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 organizations

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
- Producers and commodity groups
- Researchers in the Vegetable Industry
- Academic programs faculty and students
- Federal and State Agricultural Agencies (PRDA, USDA/APHIS, USDA/ARS, USDA/NRCS).
- American Phytopathological Society (APS), Agronomy Society of America, Horticultural Society, Puerto Rican Agricultural Sciences Society, Entomological Society of America.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of 'Pest Management Strategic Plans' (PMSPs) developed
- Number of peer-reviewed articles in major scientific journals resulting from program activities.
- Peer reviewed articles in local Scientific Journals resulting from program activities.
- Abstracts or oral presentations in professional scientific society meetings resulting from program activities.
- Poster presentations in professional scientific society meetings resulting from program activities
- 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.
- Number of program-sponsored scientific events, like symposia, topic conferences, and open houses

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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
4	Number of stakeholders knowledgeable of climate changes issues and their importance in agricultural production.

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

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

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

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 # 4

1. Outcome Target

Number of stakeholders knowledgeable of climate changes issues and their importance in agricultural production.

2. Outcome Type : Change in Knowledge Outcome Measure

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
- Other (Reduction of AES personnel)

Description

Puerto Rico has experienced changes in climatic conditions during the traditional crop growing seasons. The vegetable production area in southern Puerto Rico is already seeing the impact from the lack of rain during planting, followed by excess precipitation later in the season. A rise on food production cost has discouraged growers to keep their farm enterprises. An additional constraint is the continuous rise on agricultural inputs and the compromised economy of the Commonwealth. These

issues affect research demands and availability of funds for research and technology dissemination.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

Timely and thorough assessment of program success and direction will be carried out to gauge accomplishments and needed corrections. Base-line indicators developed during program area meetings of scientists, extension specialists, and stakeholders will continue to be monitored. Progress monitoring of program outcomes will be tracked using these indicators, and will be evaluated by program scientists. New Program direction and indicators may rise and will be evaluated once a year. The following list includes the key items in the evaluation planned:

What aspects of the program will be evaluated? (1) Assessments of the changes in pests and disease outbreaks after adoption of management practices in the main production areas; (2) Evaluation of publications, disease notes, first reports

Who will participate in the evaluation (target audience)? Growers attending annual planning meetings; researchers

Method: 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.

When: Once a year.

Expected results: Less disease outbreaks reports by growers; an increase in the number of publications in referred journals, and abstracts in meeting memoires; identification of ways in which the program implementation may be improved.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Global Food Security and Hunger - Plant genetic resources, breeding and production systems

2. Brief summary about Planned Program

The Plant Genetic Resources, Breeding and Production Systems (PGRBPS) research program plays a key role in addressing the priorities of both the PRAES and NIFA in the areas of Global Food Security, Hunger, and Climate Change. It is the strongest of our programs in terms of active projects and FTEs devoted to its research lines. The development of improved crop cultivars and better management practices (BMP) contribute to a more productive and competitive local agricultural sector. Our unique capabilities to evaluate tropical plant germplasm and develop improved cultivars and recommended production practices for the tropics, are also valuable to farmers in Central America, the Caribbean, and Africa. The United States imports of tropical fruits and vegetables from the Caribbean Basin continue increasing. Meanwhile, eighty-five percent of the food consumed in Puerto Rico is imported. The adoption of BMP may increase the availability and quality of commodities that would otherwise be imported and help control food prices.

The PRAES has the expertise, the facilities, and the germplasm and breeding lines needed to develop improved cultivars of traditional crops of economic importance. New investments are being made to upgrade facilities and re-establish a micropropagation program of economically important crops such as pineapple, banana, and yam. Production of seed and propagation materials under protected structures has also begun for cases, such as the citrus industry facing Citrus Greening, in which certified disease-free materials are needed. Program researchers are also recovering germplasm of traditional crops from US repositories, introducing new fruits and starchy crops varieties, and running performance tests under Puerto Rico conditions. Electronic publications containing descriptions of PRAES germplasm collections make the information more accessible to the public.

Improved production practices should complement genetic improvement for increasing efficiency and for reducing production costs. The development of best management practices will consider the need for production systems that conserve natural resources, improve water and fertilizer use efficiency, and promote biodiversity and natural services, such as biological nitrogen fixation and increases in soil organic matter content. New trends in organic farming, hydroponic crop production, intercropping, use of organic amendments and cover crops in the tropics require applied research to solve emerging problems from these production systems. We expect to continue conducting research and demonstration activities with some of these topics in two substations with certified organic plots.

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			12%	
202	Plant Genetic Resources			30%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			20%	
204	Plant Product Quality and Utility (Preharvest)			5%	
205	Plant Management Systems			33%	
	Total			100%	

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

1. Situation and priorities

The PGRBPS is at the core of PRAES efforts to improve food security in Puerto Rico and other tropical regions of the world. During the last decade it has been an important contributor towards solving the shortage of seed limiting the production of many traditional crops. Through the development of better management practices and more efficient production systems the program helps growers achieve higher yields and quality in their crops.

The PRAES maintains germplasm collections of several crops of economic importance. New germplasm of these crops must be evaluated in order to identify accessions with traits of economic value to be incorporated into the breeding programs, or to be released for commercial use. The introduction of adapted germplasm can address specific production constraints, or in the case of promising new crops, become a highly profitable alternative for Puerto Rico's agriculture.

The efficiency of production systems of traditional and new crops must be improved. Non-conventional production practices, such as hydroponics, organic farming, and home gardening have unique constraints that need to be addressed through research. Increased mechanization for small-and medium-scale farmers is needed in order to reduce labor costs. Cropping systems should take advantage of natural services such as the biological control of diseases and pests, incorporation of organic matter using cover crops, and biological nitrogen fixation reducing the dependence on inorganic N imports. In addition, a re-evaluation of the PRAES recommendations for traditional production systems is needed (i.e., fertilization, soil amendments, and irrigation practices) to provide our stakeholders with recommendations that permit profitable production and natural resource conservation.

The production of disease-free propagation material is increasingly needed to face the emerging diseases on the island. The construction of adequate screen houses for the production of these materials under new protected structures is now being implemented at Corozal and Adjuntas to better meet the goals of this POW. The PRAES is also upgrading its facilities in the substations of Isabela and Corozal to begin a micropropagation program with the capacity of producing plants that are free of viral, fungal and bacterial infection.

Priorities:
• Introduction, evaluation and preservation of germplasm and cultivars of crops of economic importance to Puerto Rico.
• Development of new cultivars of crops for conventional, organic, and hydroponic systems --for commercial production and for home gardening-- in order to increase yields, improve produce marketability, decrease production costs, or enhance crop value.
• Development of improved 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.
• Multiply foundation seed of traditional crops currently being planted by farmers. Select, re-evaluate and increase seed of cultivars of traditional crops not recently planted that were developed by the PRAES breeding program.

2. Scope of the Program

- In-State Research
- Multistate Research

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

1. Assumptions made for the Program

· The maintenance of adequate long-term financial support for research to permit plant-breeding programs to develop improved cultivars, and to permit researchers to develop and to update recommended production practices.
· Scientists with the expertise needed to develop crop cultivars, to maintain genetic germplasm and to conduct crop production research are available in the College of Agricultural Science.
· The seed program will be strengthened to increase the availability of seed of 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 BMPs that result in greater, more efficient, and more diverse crop production in Puerto Rico, while also addressing the challenges associated with climate change.

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
2014	0.0	0.0	11.3	0.0

Year	Extension		Research	
	1862	1890	1862	1890
2015	0.0	0.0	11.2	0.0
2016	0.0	0.0	11.0	0.0
2017	0.0	0.0	11.0	0.0
2018	0.0	0.0	11.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

- Development and release of improved cultivars of crops of economic importance such as beans, sweet corn, tanier, sweetpotato, pigeon pea, coffee and sweet cherry pepper.
- Introduce and evaluate the performance of starchy crop germplasm such as cassava, sweet potato, and plantains; and of fruit crops such as breadfruit, papaya, and achachairú.
- Electronic publication of descriptions of germplasm collections.
- Distribution of germplasm to scientists and the public
- Research and publication of technology packages describing best management practices for crops of economic importance
- In collaboration with the Agricultural Extension Service, host field days for stakeholders at different PRAES Substations.
- Increased on-farm research to validate new technology
- Publication of research results in bulletins and local newspapers 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. This information will help to establish future research priorities.
- Upgrade research facilities for the establishment of a micropropation 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, legislators, county agents, scientists, USDA professionals, professionals from the private sector and nonprofit organizations.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Records of the number and type of germplasm accessions distributed to scientists and the public.
- Number of participants in the field days coordinated with Extension or the Department of Agriculture
- Number of students attending field days to seed production fields, germplasm collections and other experimental fields.
- Number of refereed publications.
- Number of non-refereed publications.
- Number of presentations in scientific meetings.
- Number of research proposals submitted addressing Global Food security and hunger.
- Number of MS Thesis related to Global Food security and hunger.
- Number of new varieties released by PRAES
- Number of activities to inform stakeholders about established projects and their benefits

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

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.
3	Number of locally produced starchy crops with increased output according to Dept. of Agriculture statistics
4	Number of fruit crops with increased output according to Dept. of Agriculture statistic
5	Number of vegetable crops with increased output according to Dept. of Agriculture statistics
6	Number of stakeholders gaining knowledge on organic agricultural practices and acquiring certified organic seeds

Outcome # 1

1. Outcome Target

Number of stakeholders to adopt the proposed BMPs.

2. Outcome Type : Change in Action Outcome Measure

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

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 # 3

1. Outcome Target

Number of locally produced starchy crops with increased output according to Dept. of Agriculture statistics

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources
- 205 - Plant Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

Number of fruit crops with increased output according to Dept. of Agriculture statistic

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources
- 205 - Plant Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 5

1. Outcome Target

Number of vegetable crops with increased output according to Dept. of Agriculture statistics

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources
- 205 - Plant Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 6

1. Outcome Target

Number of stakeholders gaining knowledge on organic agricultural practices and acquiring certified organic seeds

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources
- 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 such as Huanglongbin or Black Sigatoka or pests like Coffee Berry Borer could also threaten some crops. The proposed activities in the plan of work are dependent on continued programmatic and fiscal support of the USDA, the Puerto Rico Agricultural Experiment Station, and the Department of Agriculture of Puerto Rico.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

Records of the planting material, or seed distributed for free, and of seed sales of cultivars developed by the AES will be maintained at the Substations. These records will provide a measure of the impact of the variety development program.

In addition, dual moderator focus groups that include farmers, extensionists and researchers will be used to obtain opinions concerning the new technologies being validated and other aspects of the program's implementation. The focus group will be convened during the spring or fall semester of the 2013/14 academic year . Questions will be focused on the program's design, on the perceived attributes

of the technologies devised, and on the perceived overall success of the program. The information obtained will be used to improve the design of the program and the dissemination strategies used with different types of audiences.

In addition to these, the use of short evaluation forms with questions on the program's progress will continue to be administered to participants at all seminars, technical trainings and commodity meetings of fields related to this program.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Climate Change: Natural Resources and Environment

2. Brief summary about Planned Program

The principal goal of the Climate Change -Natural Resources and Environment Research Program continues to be to develop, perform and support scientific research regarding the impact of agricultural practices on the environment and natural resources of Puerto Rico. The program addresses key AES mission goals by supporting both the Department of Agriculture and the Department of Natural Resources in the management of agricultural practices by (1) developing pollution prevention and mitigation practices for soil and watershed protection and management; (2) developing practices for soil improvement and maintenance; (3) developing and promoting sustainable agricultural practices; (4) supporting research on conservation of biological diversity (particularly research on the effects of non-native species on biodiversity; on management approaches for conserving and restoring biodiversity; and regarding the impact of agricultural management practices on natural ecosystems).

As part of this program area we will work with the ultimate goal of: improving stakeholder's management of agricultural practices ensuring sustainability; protecting and enhancing the island's biodiversity, soil, forest, and water resources in concert with agriculture uses; enhancing water use efficiency on agricultural production; providing leadership in developing a culture of environmental stewardship to protect soil, water quality, forest-land and biodiversity; increasing adoption of agricultural production to improve farm profitability and environmental quality; and developing long term, sustainable, economically and environmentally sound crop production systems to protect and enhance natural ecosystems. Soil management research promotes a long-term sustainable system of crop production by identifying and developing management practices to be implemented in order to reduce the amount of nutrients released to soil and/or water. Finally, research will continue in order to gather more reliable scientific data to quantify the contribution of agriculture relative to other pollultion sources, and measure the short and long-term impact of agricultural management systems on the environment.

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

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

1. Situation and priorities

The inappropriate management of crop production systems can lead to potential water and soil resources degradation. It is necessary to quantify the contribution of agriculture as a pollution source, and to measure the short-and-long term impact of agricultural operations on the environment. Water quality research will continue monitoring water quality standards in order to characterize the chemical and biological status of the most important watersheds in Puerto Rico. Development of management practices and strategies to address environmental pollution prevention and mitigation are a primary goal of this research program.

Because of the inevitable increase of inorganic fertilizer costs coupled with the negative effects of fertilizer runoff on the environment, there is a renewed interest in organic fertilizers as an environmentally friendly alternative to artificially synthesized chemicals. This situation has spurred on the development of sustainable agricultural practices as a key component to foster agricultural-led economic growth in the island. Research to address the improvement on soil quality and crop yield in tropical acid soils by using organic amendments will advance our understanding of the use of compost in the tropics and its effect on organic matter buildup, mineralization and crop yield. At the same, it will promote the most efficient use of resources in agricultural production while integrating sustainable agricultural and environmentally friendly practices.

Although research to address the impact of non-native species on natural ecosystems has been developed, there still much work to be done. Research addressing the pathways of entry, impact on the ecosystem, and management of non-native species is needed to avoid biodiversity losses and ecological degradation of island ecosystems. One of the goals of this program is, therefore, to begin research on the interactions and effects of invasive species on natural ecosystems dynamics.

In summary the main problems to be addressed by this program are (1) water resources management and quality; (2) soil erosion management and nutrient transport; (3) development of sustainable agricultural practices; and (4) biodiversity management and conservation on natural ecosystems.

Emerging research needs as identified by PRAES stakeholders and researchers for 2012-2013 are (according to their knowledge area code):

101 Identification of soil types and their suitability for specific uses
123 Forest health assessments and management practices to protect forests from insect and disease infestations
123 Native and non-native invasive species that interfere with forest management
131 Inventory and appraisal of current and potential land uses, particularly agricultural uses.
205 Sustainable agricultural practices

2. Scope of the Program

- In-State Extension
- In-State Research
- Multistate Research

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

1. Assumptions made for the Program

a. Reasonable funds, both internal and external will be available throughout the program duration
b. Personnel with adequate skills and understanding of the subject will be working in the program by virtue of availability and recruitment
c. Support and input of related agencies, such as a Department of Agriculture of PR, USDA, NRCS, EPA, local Environmental Quality Board, Department of Natural Resources of PR, and US Forest Service will be available for the activities proposed and developed.
d. Producers and the general public will adopt watershed, soil erosion and biodiversity conservation management practices developed in the program.
e. Quantitative thresholds of impairment for nutrients will be developed to comply with the USEPA mandate.
f. The appraisal of soil resources on the island will lead to a better understanding of soil biodiversity, management and conservation practices.
g. Transition to a sustainable agriculture will be spurred through the adoption of novel agricultural organic practices.

2. Ultimate goal(s) of this Program

As part of this program area we will work with the ultimate goal of improving stakeholders' management of agricultural practices ensuring sustainability, protecting and enhancing the island's biodiversity, soil, forest, and water resources in concert with agriculture uses; enhancing water use efficiency in agricultural production; providing leadership in developing a culture of environmental stewardship to protect soil, water quality, forest-land and biodiversity; increasing adoption of agricultural production systems to improve farm profitability and environmental quality; and developing long-term sustainable, economically and environmentally sound crop production systems to protect and enhance natural ecosystems. Soil management research promotes a long-term sustainable system of crop production by identifying and developing management practices to be implemented in order to reduce the amount of nutrients released to soil and/or water. This program will specifically look at changes in the management of agricultural practices and their impact on the natural ecosystems. At the same time it will promote the most efficient use of resources in agricultural production while integrating sustainable agricultural and environmentally friendly practices.

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
2014	0.0	0.0	3.5	0.0
2015	0.0	0.0	3.2	0.0
2016	0.0	0.0	3.2	0.0
2017	0.0	0.0	3.2	0.0
2018	0.0	0.0	3.2	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

a. Conduct research on (1) the development of pollution prevention and mitigation practices for soil and watershed protection and management, including behavior and fate of pesticides and other pollutants (agricultural residues) in soil and water, and the use of biological indicators to assess watershed nutritional status; (2) the development of soil improvement and maintenance practices; (3) the development and promotion of sustainable agricultural practices; (4) biological diversity (particularly research on the effects of non-native species on biodiversity; management approaches for conserving and restoring biodiversity; and the impact of agricultural management practices on natural ecosystems).

b. Publish research results in bulletins, newspaper articles, popular magazines for farmers, and in refereed journals for scientists.

c. Develop educational materials for stakeholders interested in the management and preservation of natural resources and agricultural sustainability.

d. Disseminate research results through publications, seminars, farm/field days, workshops, conferences, websites, exhibitions and any other method deemed appropriate to reach our target

audiences.

e. Develop strategies and programs to increase community involvement.

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, Faculty members and students, government partners, producers, consumers, and community-based groups.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Oral or poster presentations in professional scientific society meetings resulting from program activities
- Number of Peer Reviewed publications.
- Number of trainings, research demonstration activities and meetings with stakeholders to discuss research results and priorities.
- Number of graduate students completing a MS degree and submitting theses under research projects in this program

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Number of stakeholders gaining knowledge on pollution prevention and mitigation practices for soil and watershed protection and management.
2	Number of persons adopting practices for watershed protection
3	Number of persons gaining knowledge on biodiversity threats and losses, and on prevention practices.
4	Number of farmers adopting methods to increase soil organic matter content
5	Number of stakeholders gaining knowledge of efficient water use and conservation practices.
6	Number of stakeholders gaining knowledge effects on invasive species management practices.
7	Number of stakeholders gaining knowledge on managing approaches for conserving and restoring biodiversity and on the impact of agricultural management practices on natural ecosystems.

Outcome # 1

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 101 - Appraisal of Soil Resources
- 112 - Watershed Protection and Management
- 133 - Pollution Prevention and Mitigation

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of persons adopting practices for watershed protection

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 133 - Pollution Prevention and Mitigation

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

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

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

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

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 133 - Pollution Prevention and Mitigation
- 403 - Waste Disposal, Recycling, and Reuse

4. Associated Institute Type(s)

- 1862 Research

Outcome # 5

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 111 - Conservation and Efficient Use of Water

4. Associated Institute Type(s)

- 1862 Research

Outcome # 6

1. Outcome Target

Number of stakeholders gaining knowledge effects on invasive species management practices.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 123 - Management and Sustainability of Forest Resources
- 136 - Conservation of Biological Diversity
- 211 - Insects, Mites, and Other Arthropods Affecting Plants

4. Associated Institute Type(s)

- 1862 Research

Outcome # 7

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 136 - Conservation of Biological Diversity
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 212 - Pathogens and Nematodes Affecting Plants

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
- Competing Programmatic Challenges

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 - Planned Evaluation Studies

Description of Planned Evaluation Studies

Purpose of the Evaluation

The evaluation of the research program will have two parts: the first is a descriptive procedure that will produce a management model describing the research activities related to intended beneficiaries and expected outcomes. The second part of the evaluation effort will examine why the outcomes were or were not achieved. The primary purpose of this evaluation is to fit the programming effort through the development of a management model that describes the factors that appear to enhance or detract from the completion of stated goals and objectives.

Data collection Sources:

- CAS Mayagüez-UPR Research Program Reports; database records, peer-reviewed publications, newspaper articles
- Program's participants and beneficiaries
- Direct observation of program events and results
- Documentation of program events and activities

Data Collection Methods: Multiple data collection methods will be used to ensure a thorough account evaluation and validation of the findings.

Method	FY-2013 At Program Activities	Later
Survey	X	
Focus Group Interviews	X	
Personal Interviews		X
Observations	X	
Workshops and Seminars		X
End Section Questionnaires		

X

Document review and analysis

X

Evaluation Results

The research program coordinator and program collaborators will interpret the analyzed data. Results of the evaluation will be available through the PRAES-website to target key decision makers, colleagues, program participants and beneficiaries. Evaluation results will be used to improve the activities of the research program in order to enhance and achieve the stated goals and objectives according to the stakeholders' needs.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Global Food Security and Hunger - Agricultural Economics, Marketing, and Community Development

2. Brief summary about Planned Program

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) introduce new promising products and 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; and (8) research, analyze and educate on agriculture and natural resource management and policy alternatives.

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
601	Economics of Agricultural Production and Farm Management			15%	
602	Business Management, Finance, and Taxation			15%	
604	Marketing and Distribution Practices			10%	
605	Natural Resource and Environmental Economics			15%	
607	Consumer Economics			10%	
608	Community Resource Planning and Development			10%	
610	Domestic Policy Analysis			10%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities			5%	
902	Administration of Projects and Programs			5%	
903	Communication, Education, and Information Delivery			5%	
	Total			100%	

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

1. Situation and priorities

Farmers and rural communities in PR face increasing challenges. Globalization has made evident how vulnerable local production is to competition from abroad. Central American countries, for instance, being at latitudes close to those of PR, supply many of the same products and at the same time of the year as PR does, but in much greater quantities, with higher productivity levels, and at a fraction of the cost. The labor cost differences are particularly noticeable. Land availability and cost are also important issues, with suburban sprawl posing serious irreversible threats to the future availability of land for agriculture. The massive supply of low-cost goods by foreign competitors has lowered market prices, many times at levels that fall below the high costs of production experienced by Puerto Rican farmers. The overall effect is a loss in profitability that threatens the sustainability of PR's agriculture and the livelihoods of its rural communities. These problems highlight the need for substantial efforts to innovate, control costs, find new market niches (both within the Island and abroad), and for making better use of precious natural resources to address the economic sustainability issues faced by PR's agriculture.

Globalization has also had a profound impact on intermediaries and consumers in PR. First, there is the increasing vulnerability of PR's food chain to the occurrence of catastrophic risks. Most of PR's food consumption is imported and most of the imported foods enter the PR market through one port. In the event of a natural disaster affecting this port, the food supply for the whole Island would be disrupted. This situation has already been the case in the recent past. On the other hand, greater access to cheaper foods

has also put to the test the ability of PR consumers to take the best food consumption decisions, particularly with regards to their long term health impacts. Finally, the increasing foreign investment on local wholesale and retail businesses has increased the size of the average intermediary business, leaving many communities without enough employment opportunities, decreasing market access and bargaining power of small producers, and limiting consumer access to quality fresh foods. As a result, there is a pressing need to study the vulnerabilities of PR's food supply chain, the economic and social determinants of household food consumption choices, the development alternatives available to rural communities, as well as the nature of linkages between local farms and major food retailers.

During this POW, priority will be given to research studies and outreach efforts of economic efficiency, marketing, new products and markets, natural resource management, community agricultural development and public policy issues research and education. Both research and extension faculty will be involved in all aspects of the program. Even though alignment with agency goals is no longer required by NIFA, the program is still mainly framed to meet the food security priority, although its activities are also relevant for climate change, food safety, child obesity, and sustainable energy goals.

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 market niches, and to 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

· Adoption of improved management and decision making systems (e.g., costs of production) by Puerto Rican producers that increase competitive advantage and profitability
· Identification and adoption of improved marketing and logistics systems by PR producers and intermediaries that improve market access for PR producers and reduces vulnerabilities to catastrophic risks
· Identification and development of highly profitable new market niches, crop species and crop varieties that improve the competitive position of Puerto Rico producers.
· Identification and adoption of improved institutional arrangements by PR rural communities that allow their members to effectively (i) benefit of all the other objectives stated here, as well as (ii) participate

in public policy decisions affecting their well-being

- Adoption of improved management and decision-making systems that optimize public funds and natural resource use, by PR community leaders and government officials
- Improvement in the quality of life and food security situation of households and rural communities

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
2014	0.0	0.0	0.7	0.0
2015	0.0	0.0	0.7	0.0
2016	0.0	0.0	0.7	0.0
2017	0.0	0.0	1.0	0.0
2018	0.0	0.0	1.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

To conduct research to identify new market niches and promising new products, as well as to determine farmers' costs of production, consumer preferences, marketing margins, and farmers' and other participants' shares in the marketing channels of selected agricultural commodities.

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 the information needs of these stakeholders.

Research to improve natural resource and environmental use by farmers, and to support policy-making processess by government officials, in order to achieve greater economic and material sustainability.

In collaboration with Extension faculty and agents, results will be translated into recommendations for farmers and community organizers.

Publications will be prepared and presentations to producers' 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, academic community, local and state government officials, and other professionals.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of refereed publications
- Number of scientific presentations in scientific meetings
- Number of non-refereed publications (posters, newspaper articles, etc.)
- Number of participants attending workshops coordinated with Extension on program's results
- Number of new or improved innovations made (models, software, processes, etc.)
- Number of activities/events organized (e.g., workshops, seminars, training events, educational events)
- Number of research-based extension or outreach presentations

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Number of stakeholders gaining knowledge about public policy issues relevant to local agriculture and natural resources.
2	Number of stakeholders gaining knowledge about new information/tools (medium term measure) aimed at improving: Consumption decisions, Production management, Marketing decisions, Institutional arrangements and organizational capacities, Public policy decisions, or Natural resources and environmental management
3	Number of adopters of new or improved practices/tools in: Consumption decisions, Production management, Marketing decisions, Institutional arrangements and organizational capacities, Public policy decisions, or Natural resources and environmental management
4	Total number of participants in new market-niches generated as a result of program research

Outcome # 1

1. Outcome Target

Number of stakeholders gaining knowledge about public policy issues relevant to local agriculture and natural resources.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 608 - Community Resource Planning and Development
- 610 - Domestic Policy Analysis

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of stakeholders gaining knowledge about new information/tools (medium term measure) aimed at improving: Consumption decisions, Production management, Marketing decisions, Institutional arrangements and organizational capacities, Public policy decisions, or Natural resources and environmental management

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics
- 607 - Consumer Economics
- 608 - Community Resource Planning and Development
- 610 - Domestic Policy Analysis
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities
- 902 - Administration of Projects and Programs
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Number of adopters of new or improved practices/tools in: Consumption decisions, Production management, Marketing decisions, Institutional arrangements and organizational capacities, Public policy decisions, or Natural resources and environmental management

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics
- 607 - Consumer Economics
- 608 - Community Resource Planning and Development
- 610 - Domestic Policy Analysis
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities
- 902 - Administration of Projects and Programs
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

Total number of participants in new market-niches generated as a result of program research

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 601 - Economics of Agricultural Production and Farm Management
- 602 - Business Management, Finance, and Taxation
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics

- 607 - Consumer Economics
- 608 - Community Resource Planning and Development
- 610 - Domestic Policy Analysis
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities
- 902 - Administration of Projects and Programs
- 903 - Communication, Education, and Information Delivery

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 to 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 situation may compromise the ability of researchers to accomplish their long-term plans.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

Our program has some traditional areas of research such as production and marketing studies. However, it has recently begun or is planning to begin research covering the following broad topics: (1) identification and development of new export niches, (2) identification of public policy issues, research and educational methodologies, and public policy analyses in the areas of natural resources and the environment, and (3) development of management tools for organic agriculture. Because of our limited resources and time, our evaluation plan will focus its attention on the new research issues. We will undertake a needs and market assessment type of evaluation for these three topics. These are some of the key items of our evaluation plan:

Who will participate? Producers on topics (1) and (3), and faculty and government agents on topic (2).

Who will conduct the evaluation? Principal investigators and program coordinator.

Method: Focus groups.

When: During the Fall of 2013.

Focus of questions: Understand audience, identify audience needs, identify barriers to adoption.

Expected results: Establish baselines for measuring future progress and improved program design.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Food Safety - Food Safety, Science, Technology and Childhood Obesity (FOSSTCO)

2. Brief summary about Planned Program

The mission of the FoSSTCo program is to promote the quality of life and economic viability of the agricultural sector and rural communities by continuous improvement of current and development of new food and non-food products and their respective manufacturing and other related processes. In so doing, the Program considers such aspects as food safety, nutritional value, environmental impact, needs for education and information dissemination, consumer and industry support, and technology development, transfer and adaptation. In pursuit of the mission, special attention is given to the issue of childhood obesity and to the improvement of public health. Until a critical mass of projects is developed in this latter area we will continue planning and reporting here any research on childhood obesity.

Ongoing fiscal challenges at the University continue to limit the progress of our Agro-Industrial Innovation and Technology Center. Aside from this, research continues to focus on adding value to Puerto Rico's specialty crops. In order to achieve our goals through research, we are working in increasing the number of students that engage in graduate programs in Food Science. We continue working with the food industry in Puerto Rico. Collaborative agreements are growing between our Center and the industry, such as those with Marvel International and Goya Foods. We will continue working in food safety; we are now part of a multi-disciplinary network of scientists that will perform comprehensive and integrated risk-based research and outreach to improve the safety of food from farm to fork.

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			10%	
503	Quality Maintenance in Storing and Marketing Food Products			20%	
504	Home and Commercial Food Service			10%	
511	New and Improved Non-Food Products and Processes			5%	
701	Nutrient Composition of Food			15%	
702	Requirements and Function of Nutrients and Other Food Components			10%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			5%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins			5%	
	Total			100%	

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

1. Situation and priorities

Nourishment is essential for sustaining life. 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. However, fulfilling such a role requires agro-industry to balance its own objectives along with consumer demands, governmental regulations, and market push towards the implementation of quality management systems.

It has been estimated that Puerto Rico imports about 85% of its food. Traditionally, efforts of the Department of Agriculture of PR and the University of Puerto Rico's College of Agricultural Sciences have focused on farm production, even though experts have suggested that PR's agricultural goods are more expensive than those imported from competing countries. Agricultural economists concur on the need to add value to agricultural products as a means to revive PR's agricultural industry.

A recent study from Towson University in Maryland showed that 18% of PR's adolescent population is overweight while 23% are obese. This and similar studies paved the way for the enactment of Law 26 (January 18, 2012) for the establishment of the Advising Counsel on School Health and Obesity Control. The Counsel's mission is to advise the Department of Education in establishing measures and strategies to prevent obesity and related diseases.

In 2012, the program priorities were revisited and slightly modified to read as follows:

• Improve consumer health through the development of products and processes that add value to agricultural goods, ensuring their safety and nutritional value to the consumers.
• Strengthen the market 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.
• Define or evaluate quality parameters for fresh and processed goods, including chemical properties, safety and nutritional value.
• Characterize and reutilize harvest, slaughter or food processing wastes, residues and effluents for the development of value added goods.
• Review and promote simple food preservation technologies at home.
• Improve the safety of food from farm to table.

2. Scope of the Program

- In-State Research
- Multistate 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 that of 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's farmers must move away from fresh market production and onto a community-oriented agricultural development strategy to deliver value added products.
· If 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 the Center for Innovation and Agro Industrial Technology (CITAI), will position the Program as the 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.
· The knowledge of chemical and nutritional properties of cultivars will help identify special market niches for growers.
· Obesity and other weight-related diseases can be combated and controlled by consumer education and the availability of nutritious food alternatives.

2. Ultimate goal(s) of this Program

Promote the quality of life and economic viability of the agricultural sector and rural communities by continuous improvement of current, and development of new, food and non-food products and their respective manufacturing and other related processes, while considering such aspects as food safety, nutritional value, environmental impact, education and information dissemination needs, consumer and industry support, and technology development, transfer and adaptation. Special attention is given to the issue of childhood obesity and the improvement of public health.

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
2014	0.0	0.0	1.5	0.0
2015	0.0	0.0	1.5	0.0
2016	0.0	0.0	1.5	0.0
2017	0.0	0.0	1.5	0.0
2018	0.0	0.0	1.5	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

• Development of presentations, journal articles, Extension Service publications, and other literature contributions that make research results available to users and/or that establish guidelines or recommendations for process improvement or compliance with government regulations.
• Delivery of seminars, short courses and workshops on various topics with open registration to industry and particular individuals.
• Establishment of collaborations with industry to research specific issues affecting their products 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
- Consumers
- Federal and State Agricultural Agencies (PRDA, PRDH, USDA/APHIS, USDA/ARS, FDA)
- Food Industry representatives

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of Courses, seminars and workshops offered on the topics covered by the Program
- Number of projects or industry collaboration agreements established
- Number of people attending seminars and workshops
- Amount of grant funds (internal or external) of active projects

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Number of improvement or development projects focused on safety or nutritional aspects of product or production processes
2	Number of projects on postharvest or packaging
3	Number of projects focusing on definition of quality parameters
4	Number of projects dealing with residues, wastes or effluents

Outcome # 1

1. Outcome Target

Number of improvement or development projects focused on safety or nutritional aspects of product or production processes

2. Outcome Type : Change in Knowledge Outcome Measure

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
- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of projects on postharvest or packaging

2. Outcome Type : Change in Action Outcome Measure

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
- 511 - New and Improved Non-Food Products and Processes
- 702 - Requirements and Function of Nutrients and Other Food Components
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Number of projects focusing on definition of quality parameters

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 503 - Quality Maintenance in Storing and Marketing Food Products
- 701 - Nutrient Composition of Food

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

Number of projects dealing with residues, wastes or effluents

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products
- 702 - Requirements and Function of Nutrients and Other Food Components

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
- Government Regulations
- Competing Programmatic Challenges

Description

Natural Disasters - Puerto Rico is a tropical island located in the Caribbean. As such, it is prone to tropical storms and hurricanes. Although weather is relatively stable, episodes of drought or intense rain occur periodically.

Economy - Puerto Rico is still suffering the economic recession. As with the rest of the world, while the recession prevails, the amount of funding available for investing in research or new ventures will be limited. The University budget is still challenged by the need for reductions and cuts in personnel and spending.

Public policy changes - The agricultural sector is highly susceptible to changes in public policy as dictated by the local Department of Agriculture. The link established between the Department of Agriculture and the College of Agricultural Sciences of the University of Puerto Rico is still being addressed, but results for this program have been limited or undisclosed.

Government regulations - 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 - Program resources are not exclusively engaged with this program. Instead, they belong to other departments and need to address issues in their respective programs as required. Thus, we have a pool of researchers who are constantly entering and leaving. During 2011, we added to our staff a new scientist who focused on food nanotechnology. Apparently, that scientist left the team because of the University's inaction to consummate a new contract agreement. The uncertainty in the availability of resources is a constant challenge for the program.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

1. Conduct several meetings (probably focus groups) with FOSSTCO stakeholders (government agencies, professional organizations, producers) to assess program impact and identify opportunity or need areas.

· When: fall of every other year
· Expected results: identification of ways to improve program; updating of stakeholders' needs; identification of new opportunities in this programmatic area

2. Conduct annual internal meeting (with FOSSTCO resources only) to check progress on metrics and to validate priorities.

· Expected results: identify ways to improve the program's implementation

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Sustainable Energy - Renewable Energy Alternatives for Small Islands

2. Brief summary about Planned Program

The research program on "Renewable Energy Alternatives for Small Islands: Technological Solutions and Social, Physical, and Economic Constraints" began in 2011 in Puerto Rico, following NIFA guidelines on the need to tackle important agricultural issues and constraints facing our society. At present only a few projects are active in this area, but this scarcity may change in the future if financial resources continue to be available for this type of research and development initiatives. Two PRAES substations have already established on-grid photovoltaic installations, facilitating the development of future projects directed towards tailoring this type of technology to the needs of our stakeholders. In the long term the aim of this program is to achieve greater energy efficiency and to reduce the operating costs of farming and of agroindustrial operations on the island. This goal could be accomplished by diversifying and improving the design of the energy alternatives currently available locally, by assessing the cost-effectiveness of these alternatives, and by disseminating this information to stakeholders.

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
401	Structures, Facilities, and General Purpose Farm Supplies			20%	
402	Engineering Systems and Equipment			40%	
403	Waste Disposal, Recycling, and Reuse			40%	
	Total			100%	

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

1. Situation and priorities

Puerto Rico is a small island relying almost exclusively on imported energy resources for most of its power generation and other energy needs. The resulting high cost of energy on the island is one of the factors contributing to the high production costs faced by agroindustries in Puerto Rico, costs which in turn affect their competitive position in the market. During the 1970s energy crisis, Puerto Rico began to

develop an active biomass research program based on our still, at that time, productive sugar cane industry. Cutting-edge research on "energy cane" varieties and management as a biomass commodity was developed during the next two decades. The demise of sugar production on the island and the drying out of funding sources for renewable energy studies halted this line of research in the PRAES after the early 1990s.

More recently, the inclusion of energy sustainability as a national priority is again opening possibilities for renewable energy research geared towards the development and validation of technological alternatives and the study of their consequences and constraints. Last year the PRAES, in partnership with the Department of Agriculture of Puerto Rico, emitted several requests for proposals which included as a priority the development of alternative energy sources, particularly for coffee processing and livestock operations. Still, only a couple of projects were begun in the area of energy generation from agricultural wastes, and on the viability of using photovoltaic cells as an energy source for milking parlor operations. Promising results have been obtained with the design of a geomembrane anaerobic digester used to treat excrement from a small swine farm, and plans are underway for the optimization of the system. If successful, the optimized system will make more energy available to satisfy farms' needs and will improve the storage of biogas.

Solar radiation, through photovoltaic technology, remains the renewable energy resource more readily available for use by the island's agroindustries. Nevertheless, because of the relatively high cost of this technology, additional assessments of its suitability for different kinds of operations must be performed. Basic data to assess the viability of different technological alternatives, such as energy consumption estimates in different types of operations, are still lacking. To aid in this process and serve as a model for future initiatives, two of our PRAES substations have developed energy projects of on-grid photovoltaic installations capable of producing from 40% to 100% of the substations' energy needs. Data collected on energy consumption in these projects will help validate and tailor this type of technology to the needs of our stakeholders. Ongoing research of energy consumption in dairy operations will also be instrumental for assessing the viability of solar, eolic, or biomass-based energy alternatives for this type of operations.

In line with the island's general goal of diversifying its energy sources and achieving greater energy efficiency, current research priorities in sustainable energy include:

- Improved design and cost effectiveness of biogas producing biodigestors fueled with different types of wastes

-Cost effectiveness of photovoltaic cells for different types of agricultural operations

-Identification and evaluation of alternative, non-food crops for biofuel production, with the potential of becoming a new starting point for a biofuel industry on the island.

2. Scope of the Program

- In-State Extension
- In-State Research

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

1. Assumptions made for the Program

-Continued funding for research projects in the area of sustainable energy will be available either from local or external sources.

-Government incentives for adoption of technologies will be available.
-Relevant expertise for conducting this type of research will continue to be available in the CAS and in the College of Engineering.
-After educational activities are conducted in collaboration with the Extension Service, farmers will be convinced that adopting the suggested technologies is important for the success of their operation.
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2. Ultimate goal(s) of this Program

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To achieve greater energy efficiency and reduce the operating costs of farming and agroindustrial operations on the island by diversifying and improving the design of the energy alternatives currently available locally, by assessing the cost-effectiveness of these alternatives, and by disseminating this information to stakeholders.

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
2014	0.0	0.0	1.0	0.0
2015	0.0	0.0	0.7	0.0
2016	0.0	0.0	0.7	0.0
2017	0.0	0.0	0.5	0.0
2018	0.0	0.0	0.5	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

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-Data collection activities on energy consumption from different types of agricultural operations
-Viability studies of different types of alternative energy solutions, tailored to the conditions of farming operations in Puerto Rico
-Technological studies of energy generation from agricultural wastes and optimization of designs.
-Dissemination of results to the scientific community and to farmers, government officials, and other interested stakeholders through publications and presentations adapted to the audience
-Installation of photovoltaic systems in AES facilities to serve as a model for future initiatives.

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) Specialists and County Agents of the Agricultural Extension Service of UPR.
(2) Professional personnel of the Puerto Rican Department of Agriculture and of the USDA.
(3) Policy makers in the Commonwealth and Federal Governments.
(4) Personnel of the Farm Credit Service and other financial institutions that make loans to producers.
(5) Professionals engaged in private enterprises related to renewable energy projects.
(6) Faculty members and university graduate and undergraduate students.
(7) Farmers and managers of agroindustrial operations.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Number of active research projects in the program
- Number of new proposals submitted targeting the program's priorities
- Number of popular (non-refereed) publications based on research results
- Number of meetings held with stakeholders to extend results and technologies

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Number of participants in meetings held with stakeholders to extend project's results and technologies devised
2	Number of government agencies and other type of institutions willing to collaborate in projects promoting energy efficiency and renewable energy technologies
3	Number of farmers or agroindustrial operations becoming more energy efficient and adopting renewable energy alternatives

Outcome # 1

1. Outcome Target

Number of participants in meetings held with stakeholders to extend project's results and technologies devised

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 402 - Engineering Systems and Equipment
- 403 - Waste Disposal, Recycling, and Reuse

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of government agencies and other type of institutions willing to collaborate in projects promoting energy efficiency and renewable energy technologies

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 402 - Engineering Systems and Equipment
- 403 - Waste Disposal, Recycling, and Reuse

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Number of farmers or agroindustrial operations becoming more energy efficient and adopting renewable energy alternatives

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 402 - Engineering Systems and Equipment
- 403 - Waste Disposal, Recycling, and Reuse

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Economy
- Appropriations changes

Description

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Economy- The recession and increasing cost of inputs, may limit farmers' ability to adopt other types of technologies with long term payoffs

Appropriation changes- Availability of continued funding for research and for incentives for public adoption of technologies is vital for achieving progress in this program.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

This is a relatively new program that is still in its planning stage. During last year the initial program goals were established and a tentative logic model rationale was developed, based on the objectives of current faculty research projects and their interests in this area. This model still needs to be refined to ensure that cooperating faculty agree on the program's goals and underlying needs, on what they seek to accomplish, on how it will be done, and on which measures of progress and impact should be defined and collected. Conducting an outcome evaluation during this initial stage would not be adequate or yield fruitful results. We concluded that a more useful approach would be to conduct a process evaluation that could provide better insights on the program's ongoing implementation and could suggest changes we may want to make to improve its chances for success. The following list includes the key items in the evaluation planned:

· Who will participate in the evaluation (target audience)? Faculty with an interest in the renewable energy program; selected stakeholders or knowledgeable informants active in the field of renewable energy alternatives
· Who will conduct the evaluation? Current research administrators and program coordinators.
· Method: email questionnaire or focus group
· When: During the second year of the program (Fall, 2012; Spring, 2013)
· Focus of questions: Program design (Are program goals and priorities adequate? Are inputs and activities adequate? Is there an adequate program coordination?), Outputs (Is the program producing the outputs it was intended to produce? Are the targeted audiences aware of the program's outputs/results?), Resources (Are resources reasonable relative to the objectives? How could additional resources be leveraged?), General strengths and weaknesses, Needed program modifications (How

can the program be modified to increase effectiveness in achieving goals?)

- Expected results: We expect to identify ways to improve the program's implementation before trying to evaluate its outcomes; we also seek to understand the views of different stakeholders on issues, implementation process, etc.