2013 University of Puerto Rico Research Plan of Work

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I. Plan Overview

1. Brief Summary about Plan Of Work

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

The AES has administrative offices and carries out research activities at two main centers: Río Piedras, in the northern San Juan metropolitan area, and Mayagüez, on the west coast of the island, where the CAS Campus is located. In addition, the AES has six substations comprising more than 2,000 acres of land distributed in the different geographical and ecological zones of Puerto Rico. This wide distribution allows for the evaluation of crop and animal production systems adapted to the conditions of different ecological zones.

This POW receives input from stakeholders during yearly meetings of commodity groups and during workshops and field days. It also ponders recommendations received from farmers' organizations as well as from government officials who directly contact AES staff. This input helps to identify major constraints to agricultural production and to establish priorities that should be targeted by our research programs. We continue to conduct annual commodity group or research program meetings in which the progress of projects is discussed. Preliminary results are shared, and further input is sought for updating the commodity's research needs and priorities. All of our project proposals, formula funded or otherwise, go through a thorough merit review process, following the appropriate administrative manuals. In 2005, however, we changed the way in which our Hatch-funded research proposals are initially granted. In response to internal and external evaluations requesting that a portion of Hatch funds be allocated to projects on the basis of an annual call for proposals with the year's revised priorities, part of our formula-funded research is now locally competitively granted.

Following NIFA's guidance, all planned programs were reviewed last year 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 in its name. Although our research program is at present principally aligned with the first two national goals, we expect that alignment to gradually change in the future.

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

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

Current trends in global markets, and the challenges they pose to the continued viability of food and agroindustrial operations in Puerto Rico, underline even more the role that a responsive research program can play in the search for alternatives to the needs of stakeholders. Although the North American (NAFTA) and Central American-Dominican Republic Free Trade Agreements (CAFTA-DR) have up to now exempted Puerto Rico from its market-pricing policies, it is unclear whether these exemptions will expire in the future, and how they will affect our agricultural sector, particularly coffee, which has enjoyed a protected status since the 1930s. Moreover, changing market forces, such as the consolidation of wholesale and retail distributors, coupled with technological innovations and changing consumer behavior, have dramatically transformed the way in which food business is conducted on the island and the market share of local agriculture in the total food trade. To maintain and regain part of agriculture's competitive position, research must be directed to the analysis and solution of problems stalling production,and to the search of both alternative uses and markets for our products, and 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 the prolonged fiscal crisis has reduced the amount of local government payments and subsidies to farmers. The situation of the most important local commodities has been further complicated by the introduction of new devastating pests and diseases, such as the coffee berry borer (Hypothenemus hampei), the black sigatoka(Mycosphaerella fijiensis) in plantains and bananas, and, most recently, of citrus greening (Huanlongbing) in citrus fruit orchards.

Rising imported food prices have, nevertheless, attracted increased public attention to Puerto Rico's fragile food security, and to the urgent need to adopt measures to protect agricultural resources and augment the output of the farm economy. While the state university system is facing budget cuts which certainly affect our overall long-term planning and ability to strengthen all research programs, additional efforts are being made to refocus priorities and to invest in those areas considered critical to the maintenance of our food system and natural resources. Among these, crop protection studies figure prominently in the profile of projects approved last year to deal with new pests and diseases limiting the output of the island's crops. In addition, to address the shortage of seeds of some of our traditional food crops, several new projects were established to increase the production of the most promising lines developed by our breeders over the

years. Finally, to further address food security concerns increasingly brought about in our meetings with stakeholders and by the local media, we also expanded our ongoing program of introduction, evaluation and preservation of germplasm of crops of importance in the local diet.

Aware of the connections between climate change, new invasive species threats, and the need to improve the island's food security, we concluded last year the first phase in the reconversion of underutilized laboratory space at our Río Piedras center into a Certified Quarantine and Beneficial Insect Rearing Facility. The quarantine facility, financed by pooling local and external resources and leveraged by our formula-funded projects and faculty, will enable the laboratory to develop biological control technologies for invasive pests entering Puerto Rico, or threatening the U.S. through the Caribbean pathway. External funding has alreadybeen secured to initiate the second phase of this project. Strategically, we expect this initiative to help our Integrated Management of New and Emerging Pests (IMNEP) and Natural Resources and Environment (NRE) programs to develop systematic methodologies for dealing with exotic pests in the areas of (1) risk assessment, (2) early detection and invasion pathway analysis, (3) rapid development of control or eradication measures and, (4) improved sustainable pest management practices through biological practices.

In addition, renewed government-academia collaborations to promote farmers' entrepreneurial skills and output increasing technologies are expected to continue in the future. With funds assigned to the local Department of Agriculture (DA) by the state legislature for the applied research of urgent problems, we have already implemented three competitive calls for proposals and initiated several research projects directly targeting the priorities identified by the DA. In the short run, additional measures are being taken within the CAS to quickly extend research-based farming alternatives to interested stakeholders, and to educate consumers on the benefits of supporting our local farm sector. Progress continues towards the integration of research and extension programs in the areas of food science and technology, meat production, and integrated pest management.

We are also intent on helping farmers succeed in the new local niche market for organic products. Two AES substations have already obtained USDA certification for several plots operated organically during the past three years, and researchers and extensionists associated with the initiative have been hosting demonstrations attheir project's site to interested farmers, agronomists, and government officials. In Gurabo, the location of the initial organic pilot farm, a new development plan was advanced last year in which the organic farm is envisioned as the fulcrum of a broader effort to expand research in sustainable agriculture, urban farming, and agro-forestry research and education.

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 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. Although to comply

with NIFA's guidelines an independent **Childhood Obesity** program was created, at present we are not conducting research in this area. Until a critical mass of research projects is developed, any activity related to childhood obesity will be reported under the FOSSTCO program.

In the case of our **Meat and Milk Production** program, local analysts stress the need for livestock industries to become more efficient and more productive, both from the point of view of food security and of making a positive contribution to the mitigation of results of climate change. Although research oriented to deliver productivity gains will continue (through improved tropical forage production and utilization, and enhanced animal performance through better feeding, genetic selection, reproductive management and other methods), 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 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 AES 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 expected 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 be given to research addressing alternative control practices for recently identified diseases and pests, such as the Coffee berry borer, "citrus greening" and Black Sigatoka. The use of reduced risk practices for pest and disease control, and the selection of biocontrol agents efficient for the major pests are also among our top priorities. 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 strengthen 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. However, whereas the core of our program will remain focused on water-related issues (watershed protection, management, planning, and water quality), soil management, and biodiversity research--particularly in forestry and on the biology and spread of invasive species; program participants suggest that emerging research needs such as improved methods for mitigating environmental impacts and biosecurity risk from agricultural wastes, should also be incorporated into the program's long term goals.

This POW revision also incorporates a new program, still in its planning stage, on **Renewable Energy Alternatives for Small Islands.** Only a few research initiatives are presently active in this area, but these may increase in the future. The cost of electric energy in Puerto Rico is two times greater than the average cost in the United States. The principal reason for high-energy prices on the island is its almost complete dependence on fossil fuels, oil in particular. The high cost of energy is one of the factors increasing production costs for agroindustries in Puerto Rico, 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

Devising indicators that could serve as measures of the programs' progress toward the modified priorities has not been an easy task. Researchers are aware that in order to obtain reliable measures and data on actual adoption of recommended practices and technologies, closer collaboration with Extension needs to continue. Even so, reliable data is not always readily available.

This year, following NIFA guidelines, all of our programs incorporated an evaluation component to their proposed plan of work. Some, still in their initial formulation years, decided to conduct a process evaluation that could provide better insight on the program's ongoing implementation, and could suggest changes to improve its chances for success. These evaluations will be performed through the implementation of short surveys and/or focus groups. Other already mature programs decided to use the short evaluation forms distributed at all educational and training events to assess whetherparticipants were gaining useful knowledge from the events' organizers, and their degree of willingness to adopt the recommended management practices in their operations. Still other programs have decided to use multiple data collection sources and methods, at different stages in the program's development, to conduct a more comprehensive evaluation of the factors that appear to enhance or detract from the achievement of the programs' stated goals and objectives. Program coordinators are nevertheless aware that to implement more thorough evaluation processes 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 development. @font-face { font-family: "Arial"; }@font-face { font-family: "Courier New"; }@font-face { font-family: "Wingdings"; }p.MsoNormal, li.MsoNormal, div.MsoNormal { margin: 0cm 0cm 0.0001pt; font-size: 12pt; font-family: "Times New Roman"; }div.Section1 { page: Section1; }ol { margin-bottom: 0cm; }ul { margin-bottom: 0cm; }

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

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.0	0.0	61.8	0.0
2014	0.0	0.0	61.5	0.0
2015	0.0	0.0	61.2	0.0
2016	0.0	0.0	60.3	0.0
2017	0.0	0.0	60.0	0.0

II. Merit Review Process

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

- Internal University Panel
- Expert Peer Review

2. Brief Explanation

There has been no significant change in our Program Review Process since our last year update was submitted. In 2005, however, we changed the way in which our Hatch-funded research proposals are initially granted. In response to internal and external evaluations requesting that a portion of Hatch funds be allocated to projects on the basis of an annual call for proposals with the year's revised priorities, part of our formula-funded research is now competitively granted within CAS on the basis of said proposals. More specifically, the scientific peer review process of Hatch proposals is the following:

An annual call for proposals which includes the year's revised research priorities is prepared and distributed by the AES Research Office. Proposals are submitted to the Assistant Dean for Research with the preliminary endorsement of the respective Department Head. The Assistant Dean for Research sends the proposal again to the corresponding department head, to a local peer reviewer and to an external reviewer for their written comments on the scientific merit of the proposed research and compliance with the AES strategic plan. Proposals and their reviewers' input are discussed and evaluated by the CAS Associate and Assistant Deans for Research, and a final decision is taken by the administration. Project directors of the selected proposals are given the opportunity to incorporate reviewers' suggestions and make adjustments as appropriate. These proposals are then sent to the USDA-NIFA Office of the Administrator, where the respective national program leaders review them. Once the proposals are approved in Washington, the new or revised projects are included in the AES research program.

III. Evaluation of Multis & Joint Activities

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

As previously explained, this 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 AES research program. Because the AES cannot address all the issues identified at the same time, annual meetings of the commodity groups continue to be held to evaluate research progress and to reassess research priorities. The list of priorities assembled through this process 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 AES 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)?

A truthful evaluation of this question in the context of Puerto Rico requires further specification. Puerto Rico's population is almost totally Hispanic, with 45% of families living below the federally defined poverty line. In addition, joblessness is much higher than in any of the 50 states, a condition only made worse by the current economic recession. Therefore, the vast majority of the island's population qualifies as "under-served and under-represented" citizens in Federal government Programs. Moreover, compared with the assistance that other sectors such as manufacturing have received over the years, agriculture and rural areas in general, have lagged behind in public investment by the Commonwealth government. In this context, this POW'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, 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. 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 orderto make theadjustments 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.

This year, following NIFA guidelines, each planned program incorporated a more formal evaluation section. Most programs propose that a written report be prepared of the evaluation outcomes to be shared at program meetings and with AES 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. Althoughthere has been an historic connection between these three activities, before the current POW's implementation researchers did not report progress and impact of research beyondthe traditional publications, theses, seminars and field days describedin annual reports. Similarly, whereasextension 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 beenclosely cooperating in the fulfillment of their shared goals. Also, beginning this 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. Although it may still take some additional time to implement, discussions are already under way to consolidate both Plans of Work and Annual Reports into only one document; a measure thatwe 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 AES research programs. Stakeholder input is also considered during the establishment of research priorities. First, the AES will continue to celebrate an annual meeting with researchers, extension faculty, farmers and other members of the public interested in the work performed by the different programs or commodity groups. In these meetings the progress of active research projects is discussed, preliminary results are shared and further input is sought from participants to update research needs and priorities. The meeting is usually celebrated in the Research Center or Substation closest to the principal area of production, and coordinated with the Agricultural Extension Service commodity specialist and agricultural agents of the region. Both the commodity leader and 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 AES 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 AES 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

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 outreach efforts undertaken in this program seek to improve the biological efficiency of livestock production and the economic returns to producers of the various types of livestock of present or potential importance in Puerto Rico. The impact that we seek to achieve at the farm level relies on educational efforts both to insist on implementation of long-established good management practices and to encourage adoption of innovative procedures. Recommended management practices (RMP) may be of either of these categories and are selected according to the criteria of feasibility of implementation and magnitude of expected impact. If successful, these endeavors should eventually contribute to an increased volume of livestock production and higher quality of foods of animal origin offered to the consuming public at accessible prices, thus fostering increased food security. Current research emphasizes improved forage production and utilization to reduce feed costs; improved animal genotypes adaptable to local conditions and of high productive potential; efficient feeding and reproductive management; alleviation of thermal stress and promotion of animal comfort; control of internal and external parasites and of other infectious and non-infectious health disorders. Furthermore, lessening the environmental impact resulting fromlivestock-producing operations is an additional concern of increasing importance.

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

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

1. Situation and priorities

Concentrate feeds typically constitute the main dietary sources for non-herbivorous livestock and,in Puerto Rico,even the diets of a majority of dairy cows include more dry matter from concentrates than from forages. This has been possible in spite of the increased cost of imported concentrates in recent years by periodic increases in the price for milk paid to producers, which in turn are passed on to the consuming public as increased retail prices. However, this scheme has been stretched to its limit, as fluid milk sales have dropped with each successive price increase. Also contributing to declining milk sales has been the depressed state of the economy for at least the last five years, with high unemployment and lowered consumer purchasing power. There is little chance of concentrate feed prices declining appreciably in the foreseeable future;thus the sustainability of the local dairy industry will depend on more efficient useof traditional concentrates and agro-industrial by-product feeds in addition to increased production and utilization of high-quality forages in animal feeding. Second in importance for more efficient livestock production isthe need for better reproductive performance in both dairy and beef cattle and inswine. The UPR beef herd is setting a good example in this regard, but most private beef herds are well below this standard. Among dairy herds,even that of the UPR lacks optimal reproductive performance. Research on environmental physiology and onpractical means of reducing animal stress isalso important in this tropical environment in which unprotected animals can be subjected to thermal stress for at least some hours daily during all seasons of the year. Hopefully research in progress on genetically short-haired Holstein cattle will lead to dairy cattle better adapted to local conditions.

2. Scope of the Program

- In-State Research

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

1. Assumptions made for the Program

(1) As older Department of Animal Industry faculty members retire, they will be replaced by young scientists, trained in the pertinent academic specializations, and hired with joint teaching-research, teaching-extension, or research-extension appointments.
(2) Funding from all federal, commonwealth, and private sources will be sufficient to enable satisfactory progress in the research and extension activities of this program area.
(3) Effective communication with livestock producers and their employees will be achieved by a variety of educational methods with emphasis on field days and training sessions on the farms of producers where RMP are in use.
(4) The trend toward larger but fewer dairy herds on the island will slow down as some producers switch from management with a high degree of animal confinement to greater use of improved grazing pastures; however ownership of some farms will change as producers unwilling to change their inefficient habits leave the dairy business.
(5) Most of the specialized beef herds will be able to survive only if more equitable schemes for pricing animals sold are adopted, along with classification of local grass-fed beef to differentiate it from imported feedlot-fed beef and thus to increase its sales value.
(6) Swine and small ruminant production will continue to attract only small scale producers and non-intensive management of sheep and goats.
(7) Intensive production of broilers will continue to make an important contribution to the agricultural economy of the island, but less intensive methods of poultry meat and egg production, including organic products with increased sales value, will begin to appear.

2. Ultimate goal(s) of this Program

The work carried out under this program seeks to foster a greater degree of food security in Puerto Rico by increasing the quantity and quality of locally produced foods of animal origin, while also improving the economic returns of livestock producers and whileincreasing the impact of the livestock industries on the local economy by creating more employment opportunities both on the farm and alsoin related processing, distribution and sales activities. An ancillary goal is to protect agricultural lands by keeping them profitably engaged, thus maintaining their availability for future agricultural use and also by retainingtheir contribution of environmental services, important to the ecological wellbeing of the island.

V(E). Planned Program (Inputs)

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

Year	Extension		Research	
	1862	1890	1862	1890

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.0	0.0	10.0	0.0
2014	0.0	0.0	10.0	0.0
2015	0.0	0.0	10.0	0.0
2016	0.0	0.0	9.5	0.0
2017	0.0	0.0	9.5	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

(1) Maintain communication with researchers of the existing work groups (i.e., dairying, beef cattle, small ruminants, and forages) and those working in other areas without recognized work groups at present, to promote their efforts to undertake and complete experimentation and to submit for publication in peer reviewed journals their experimental findings.

(2) Use experimental results in conjunction with economic considerations to establish RMP to be emphasized for adoption on producers' farms.

(3) Organize meetings of researchers with producers and key government officials to discuss the situation of the major livestock industries, and explain research activities and pertinent findings, with the intention of receiving input from producers as to the relevance of present research and outreach endeavors.

(4) Organize field days and training sessions, especially at the farms of producers who are successfully using specific RMP.

(5) Continue educational efforts aimed at producers through a variety of methods, including printed material, such as the serial publication of the beef cattle working group, "La Res Informativa", and the newspaper of the private sector dedicated to all agrarian topics, "Agrotemas". Postings on the internet, radio and television broadcasts, as well as farm visits are also part of continuing education.

(6) Maintain a presence in academic circles by participating in meetings of scientific societies and in conferences and seminars at university or other venues.

(7) Continue to collaborate with the Department of Agriculture of Puerto Rico to promote its projects designated UCAR (Spanish acronym for Units of Quality and High Yield) including those involving producers of milk, beef and forages for sale.

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 of the following types of farm animals and related products: milk cows and replacement dairy heifers, bovines for meat, sheep and goats for meat, swine, rabbits, poultry for meat and eggs, and commercialized forages.
(2) Private sector entrepreneurs or employees working as sales or service people in related businesses.
(3) Officials and policy makers of the USDA and PR Department of Agriculture.
(4) Personnel of the Farm Credit Service and of other pertinent financial institutions.
(5) Personnel of the Agricultural Extension Service of the UPR.
(6) Teaching faculty not engaged in research of the College of Agricultural Sciences, UPR.
(7) Graduate and undergraduate students with interest in animal production and related fields.
(8) High school students of Vocational Agriculture.
(9) 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 industry's situation and research priorities
- Number of popular (non-refereed) publications based on research results.
- Number of field days held in research facilities and/or private farms to demonstrate RMPs based on research results.
- 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 livestock producers participating in field days willing to adopt the RMPs demonstrated.
2	On farm income from sale of livestock and related products, as percentage of base year 2010-2011.

Outcome # 1

1. Outcome Target

Number of livestock producers participating in field days willing to adopt the RMPs demonstrated.

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
- 601 - Economics of Agricultural Production and Farm Management

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

On farm income from sale of livestock and related products, as percentage of base year 2010-2011.

2. Outcome Type : Change in Condition 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
- 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 (Loss of agricultural lands, Chan)

Description

Natural Disasters (Adverse weather conditions) - Livestock enterprises are to a greater or lesser degree at the mercy of the vagaries of weather. Irrigation is not available in the majority of land devoted to forage production in Puerto Rico; rainfall must be depended upon. Prolonged droughts occur in some years with negative effects on vegetative growth and livestock productivity. At other times excessive rainfall can cause flooding of agricultural lands, causing harm to both crops and animals.

Economy- High costs of necessary inputs- A large part of the inputs needed for local livestock production are imported and their cost is beyond local control. The costs of land and labor are also notably higher here than in most of the countries that export livestock products to Puerto Rico.

Competition from imported foods of animal origin- Puerto Rico is unable to protect local producers from the competition of imported meat and other livestock products which are either subsidized or produced in countries with much lower costs.

Reduced consumer purchasing power-The so-called Great Recession accelerated the preexisting downward trend in various sectors of the Puerto Rican economy. The result has been high levels of unemployment and underemployment with declining income for a considerable part of the local population. The question arises as to whether further increases in the retail price of fresh milk will put its cost beyond the purchasing power of many low-income consumers.

Appropriation changes- Austerity in public finances and institutional funding: Nearly all of the agencies of the Commonwealth Government have received reduced allocations, including the Department of Agriculture and the University of Puerto Rico. The Agricultural Experiment Station is facing the most difficult budget situation in recent history. How long the present crisis will last is impossible to foresee.

Diminished institutional human resources- The Department of Animal Industry lost to retirement two Extension Service Specialists who worked in the dairy sector in early 2010, and a third Specialist in the swine sector in early 2011. Several administrative positions have been filled with faculty members with research and extension appointments, thus reducing the effective FTE devoted to this program. There is little chance of these vacancies being filled as long as the present budget situation exists; this situationwill diminish contacts with producers to the detriment of Program outcomes.

Other- Loss of agricultural lands- If the long-term trend toward the conversion of lands to non-agricultural uses is not stopped, there will be no room for extensive types of livestock production within the span of a few decades.

Changing Food habits of consumers- In Puerto Rico many individuals and families avoid meal preparation at home and purchase prepared foods which often include few locally produced ingredients. The disadvantages of this situation are: (1) a less healthy diet for the public, (2) loss of demand for locally produced foods, and (3) increased food insecurity. This problem represents a big challenge to devise more effective marketing strategies for local products.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

At all educational and training events the organizers will request participating producers to fill out a short questionnaire to indicate whether they have gained useful knowledge from their participation,and to choose amongfour options which express their willingness to employ demonstrated RMP in their own operations: (A)none, (B) minimum, (C) moderate, and (D) considerable. 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 that could benefit them. The corpus of RMP isexpected to contribute to enhanced on-farm production efficiency and the food security of Puerto Rico.Verification of their implementation on producers' farms will be the final step in our outreach efforts.

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 changethat could benefit them. We also expect to identify ways to improve the program's implementation and alsoways in which information is to beshared.

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 primary food security constraints in Puerto Rico are new pest and disease introductions and changes in rain patterns that result in excess moisture or drought. PRAES continued to use the available methods for disease identification and achieved the goal of identifying the causal agents of emerging diseases affecting citrus, cucurbits, papaya, tomatoes, cilantro and tuberous crops. The characterization of Squash Vein Yellowing Virus (SqVYV), a novel whitefly-transmitted potyvirus member of the genus Ipomovirus, was a major breakthrough. A coat protein gene fragment was amplified by reverse transcription (RT)-PCR with SqVYV primers from total RNA of watermelon plants with sudden vine decline symptoms. Ralstonia solanacearum race 1 in tomatoes and Pythium coloratum in cilantro were identified with PCR, Hi-Fidelity and sequencing of the internal transcribed spacer regions of nuclear ribosomal DNA. Advances in the studies of powdery mildews resulted in the identification of Oidium caricae,and Oidium sp.Podosphaera xanthii were found infecting various species of cucurbits in the island. For the first time Podosphaera fusca was identified causing powdery mildew in okra, Abelmoschus esculentus. Eryshiphe heraclei, E. peruviana, E. quercicola and Podosphaera fusca are new reports for Puerto Rico.

Surveys determined that soybean cyst nematode (SCN) is limited to a farm in Isabela. The studies will continue to prevent the spread of SCN to the soybean production area in southernPuerto Rico. PRAES will continue to increase new diagnostic capacity for Phytoplasma identification in important agricultural crops. Research on the components of a pest management program for the coffee berry borer (CBB) will continue with the monitoring of the pest and its natural enemies. The virulence of the indigenous Beauveria bassiana in laboratory and field bioassays will determine the suppression of CBB. Research directed in the search for endophytic bacteria commonly found in coffee identified endemic Bacillus thuringiensis andB. pumilus as potential biocontrols for CBB.

Natural enemiesof the Asian Citrus psyllid(ACP), vector of the bacterium Candidatus Liberibacter asiaticus, were identified. Field studies will continue to determine the most effective and the less detrimental insecticide for the control of the ACP. Replicated field experiments will study the effect of guava as a barrier, and of Murraya paniculata as a trap plant for the psyllid vector. The Anastrophe fruit fly was collected in native forests; this finding will provide relevant information to model potential fruit fly abundance across landscapes and will serve to delimit fruit fly free zones. AES works closely with the State Department of Agriculture, USDA/ARS and APHIS/PPQ to continue the surveillance and identification of exotic pests and diseases in Puerto Rico. AES will sustain this progress and will address Global Climate Change incorporating alternative methods to manage new pests and diseases that will lead to the increase of food availability in Puerto Rico

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

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

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

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

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
211	Insects, Mites, and Other Arthropods Affecting Plants			21%	
212	Pathogens and Nematodes Affecting Plants			32%	
215	Biological Control of Pests Affecting Plants			21%	
216	Integrated Pest Management Systems			26%	
	Total			100%	

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

1. Situation and priorities

Puerto Rico's agriculture faces the reduction of farmland and the constant threat of exotic pests and diseases. The priorities continue to address the 1) implementation of accurate pest and disease identification; 2) improvement of cultivars for disease resistance; 3) use of reduced risk practices for pest and disease control; 4) selection of biocontrol agents efficient for the major pests; and 5) generation of information and dissemination of results. Significant progress was made with the implementation of molecular methods for bacterial, viral and fungal pathogen diagnosis. The AES is moving towards developing a National Plan for the production of disease-free nursery stock for citrus plants. Five citrus diseases will be added to the Diagnostic Capacity of PRAES. A certification process in nurseries and orchards will be implementedforCitrus Variegated Chlorosis, Citrus Black Spot, Citrus Canker, Citrus Tristeza and Citrus Greening. In the second priority the collaboration with plant breeders has been essential for the development and release of resistant cultivars. In response to the demand for new environmentally safe fungicides, PRAES will emphasize in the evaluation of parasitoids and beneficial organisms directed to pest and diseases that are currently affecting important crops. There is a growing interest in availability of cultural practices that decrease the effect of pathogens for organic production. Outreach to producers concerning the implementation of developed practices to manage diseases is increasing. There is a demand of information about the performance of new pesticides and insecticides for vegetables and fruits.

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

- Scientists and technical personnel are available to conduct the research planned
- The necessary funds will be available from a combinations of external and internal resources
- Baseline research results and data will be available to develop the PMSPs for most crops.
- The input from partners of the Extension Service, USDA/APHIS, Puerto Rico's Department of Agriculture and producer groups will be available

- IPM practices suggested and pest management strategic plans will be adopted by growers in 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
2013	0.0	0.0	14.1	0.0
2014	0.0	0.0	14.0	0.0
2015	0.0	0.0	13.5	0.0
2016	0.0	0.0	13.5	0.0

Year	Extension		Research	
	1862	1890	1862	1890
2017	0.0	0.0	13.0	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 partner-mediated PMSPs for crops in Puerto Rico.
- 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

- Coffee, Citrus and Vegetable growers
- Banana and Plantain growers
- Ornamental growers
- Growers of Cucurbits - South of USA and Puerto Rico
- IPM Specialists
- Researchers in the Vegetable Industry
- Forest and Land Managers

- Undergraduate and Graduate Students from Crops and Environmental Sciences
- 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.
- Consumers and homeowners

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. Base-line indicators developed during program area meetings of scientists, extension specialists, and stakeholders will continue to be monitored. The progress of program outcomes will be tracked using these indicators and evaluated by program scientists. New Program direction and indicators may rise and will be evaluated once each 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 research program plays a key role in addressing the research priorities of both the AES and NIFA in the areas of Global Food Security and Hunger, and Climate Change. The development of improved crop cultivars and better management practices (BMP) contribute to a more productive and competitive local agriculture sector. Given our tropical environment and diverse cropping system that includes large numbers of small-scale farmers, much of the plant breeding and crop production research conducted by the AES is distinct from agricultural research conducted on the U.S. mainland. Our unique capabilities to evaluate tropical plant germplasm and develop improved cultivars and recommended production practices for the humid tropics are, however, of potential value to farmers in Central America and the Caribbean. U.S. imports of tropical fruits and vegetables from the Caribbean Basin continue to increase. Eighty-five percent of the food consumed in Puerto Ricois imported. The adoption of BMP can help to control prices and improve the quality of these imported commodities.

The AES maintains germplasm collections of several crops of economic importance. Electronic publications containing descriptions of these collections will help make the information more accessible to the public. Germplasm of some crops needs to be introduced and evaluated in order to address specific problems such as Black Sigatoka of bananas and plantains, or Citrus Greening. In the case of the latter, and similar fruit and vegetable cases in need of certified disease-free materials, the AES is beginning to produce seeds and propagation materials under protected structures. 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 Ricoconditions.

The AES has the expertise, facilities, the germplasm and breeding lines needed to develop improved cultivars of traditional crops of economic importance. Improved production practices should complement genetic improvement to increase efficiency and reduce production costs. Research needs to be conducted with traditional crops as well as crops having potential for commercial production in Puerto Rico. The development of best management practices will consider the need to develop 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 the resulting problems by these production systems. We expect to continue conducting research and demonstration activities withsome of these topics in the two substations with recently 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			20%	
202	Plant Genetic Resources			20%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			25%	
204	Plant Product Quality and Utility (Preharvest)			5%	
205	Plant Management Systems			30%	
	Total			100%	

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

1. Situation and priorities

New germplasm collections of crops of economic importance in Puerto Rico are needed to provide seed and material for propagation for commercial production. The new collections must be evaluated in order to identify accessions with traits of economic value to be incorporated into breeding programs, or to be released for commercial use. The introduction of adapted germplasm can address specific production constraints.

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

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

• 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 protected structures is now being implemented at the PRAES to better meet the goals of this POW.

• A re-evaluation of the AES 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.

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

Priorities:

• Introduction, evaluation and preservation of germplasm and cultivars of crops of economic importance in Puerto Rico.
• Development of new cultivars of crops of economic importance in Puerto Rico for conventional, organic, and hydroponic systems --for commercial production and for home gardening-- in order to increase yields, improve marketability of produce, lower 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 by farmers that were developed by the AES 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.

V(E). Planned Program (Inputs)

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

Year	Extension		Research	
	1862	1890	1862	1890

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.0	0.0	18.7	0.0
2014	0.0	0.0	18.5	0.0
2015	0.0	0.0	18.5	0.0
2016	0.0	0.0	18.2	0.0
2017	0.0	0.0	18.2	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 AES 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

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

- Number of farmers planting newly released varieties developed by PRAES.
- The number of 'hits' on project-related web sites. Records of the sale of hard copies of AES publications.
- 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
- 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 AES
- Number of collaborations established with public sector institutions to address production problems in agriculture
- 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	Percentage of locally produced food.
4	Number of locally produced starchy crops with increased output according to Dept. of Agriculture statistics
5	Number of fruit crops with increased output according to Dept. of Agriculture statistic
6	Number of vegetable crops with increased output according to Dept. of Agriculture statistics

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

Percentage of locally produced food.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources
- 204 - Plant Product Quality and Utility (Preharvest)
- 205 - Plant Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

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 # 5

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 # 6

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

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 Bean 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 semester of the 2013

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. We acknowledge the need for research projects in the field of climate change in order to increase knowledge about these issues. Finally, our aim is to promote the regional excellence in the domain of energy and climate change for the Neotropics by highlighting the use of novel practices in the region.

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
101	Appraisal of Soil Resources			4%	
102	Soil, Plant, Water, Nutrient Relationships			14%	
111	Conservation and Efficient Use of Water			1%	
112	Watershed Protection and Management			18%	
121	Management of Range Resources			2%	
123	Management and Sustainability of Forest Resources			12%	
133	Pollution Prevention and Mitigation			21%	
136	Conservation of Biological Diversity			10%	
211	Insects, Mites, and Other Arthropods Affecting Plants			9%	
216	Integrated Pest Management Systems			2%	
402	Engineering Systems and Equipment			1%	
403	Waste Disposal, Recycling, and Reuse			4%	
405	Drainage and Irrigation Systems and Facilities			2%	
	Total			100%	

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

1. Situation and priorities

Inappropriate management of crop production systems can lead to potential environmental 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. 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 on 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 time, it will promote the most efficient use of resources in agricultural production while integrating sustainable agricultural and environmentally

friendly practices.

The introduction of non-native species to both natural and agricultural ecosystems represents a serious threat to biodiversity, wildlife habitat, and agricultural production. 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.

In summary, the main problems to be addressed by this program are the limitations of land and water in Puerto Rico, and problems associated with soil erosion, and protection and conservation of biodiversity.

A sampling of emerging research needs for 2011-2012, as identified by PRAES stakeholders and researchers are:

Identification of soil types and their suitability for specific uses
Use of manure and other organic materials as plant nutrient sources
Forest health assessments and management practices to protect forestsfrom insect and disease infestations
Development of Agricultural Land Reservoirs
Effects of non-native species on biodiversity
Energy conservation relative to structure, facilities and agricultural production
Improved methods for mitigating environmental impactand biosecurity risk from agricultural wastes

2. Scope of the Program

- 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 inagricultural 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
2013	0.0	0.0	11.1	0.0
2014	0.0	0.0	11.1	0.0
2015	0.0	0.0	11.1	0.0
2016	0.0	0.0	11.0	0.0
2017	0.0	0.0	11.0	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 natural resources enhancement, dry forest ecology and management, microirrigation scheduling, and other soil enhancement and water conservation practices
2	Number of farmers adopting microirrigation management practices
3	Number of persons adopting practices that prevent biodiversity threats and losses.
4	Number of farmers adopting methods to increase soil organic matter content
5	Number of farmers reporting increased water use efficiency in their farms
6	Number of farmers that adopted practices to improve water resources.
7	Number of stakeholders gaining knowledge on organic agricultural practices.
8	Number of persons gaining knowledge effects of non-native species on biodiversity.

Outcome # 1

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 123 - Management and Sustainability of Forest Resources

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of farmers adopting microirrigation management practices

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 111 - Conservation and Efficient Use of Water
- 112 - Watershed Protection and Management
- 405 - Drainage and Irrigation Systems and Facilities

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 136 - Conservation of Biological Diversity

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

Number of farmers adopting methods to increase soil organic matter content

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 403 - Waste Disposal, Recycling, and Reuse

4. Associated Institute Type(s)

- 1862 Research

Outcome # 5

1. Outcome Target

Number of farmers reporting increased water use efficiency in their farms

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 111 - Conservation and Efficient Use of Water
- 405 - Drainage and Irrigation Systems and Facilities

4. Associated Institute Type(s)

- 1862 Research

Outcome # 6

1. Outcome Target

Number of farmers that adopted practices to improve water resources.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 111 - Conservation and Efficient Use of Water
- 112 - Watershed Protection and Management
- 405 - Drainage and Irrigation Systems and Facilities

4. Associated Institute Type(s)

- 1862 Research

Outcome # 7

1. Outcome Target

Number of stakeholders gaining knowledge on organic agricultural practices.

2. Outcome Type : Change in Knowledge 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 # 8

1. Outcome Target

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

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

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

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-1013

	At Program Activities	Later
Survey		X
Focus Group Interviews		X
Observations		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 AES-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 policy alternatives and consequences. Addressing the economic sustainability issues faced by Puerto Rico's agriculture is crucial for improving the sector's contribution to the island's food security.

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

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

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

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

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management			30%	
604	Marketing and Distribution Practices			30%	
605	Natural Resource and Environmental Economics			5%	
607	Consumer Economics			10%	
608	Community Resource Planning and Development			10%	
610	Domestic Policy Analysis			15%	
	Total			100%	

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

1. Situation and priorities

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, community agricultural development and public policy issues research and education. Both research and extension faculty will be involved in all aspects of the program. The program has experienced some modifications in the past two years to meet Federal research priorities. In particular, the program has been reframed mainly to meet the food security priority, although its activities are also relevant for climate change, food safety, 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 by PR community leaders and government officials, which optimize public funds and natural resource use

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
2013	0.0	0.0	2.7	0.0
2014	0.0	0.0	2.7	0.0
2015	0.0	0.0	2.8	0.0
2016	0.0	0.0	2.8	0.0
2017	0.0	0.0	2.8	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 their information needs of these stakeholders.

Research to improve natural resource and environmental use by farmers and to support policy-making process 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 (models, software, processes, etc.) made
- Number of activities/events organized (e.g., workshops, seminars, training events, educational events)
- Number of research-based extension 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 (this year) 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)

- 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
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics
- 607 - Consumer Economics
- 608 - Community Resource Planning and Development
- 610 - Domestic Policy Analysis

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
- 604 - Marketing and Distribution Practices
- 605 - Natural Resource and Environmental Economics
- 607 - Consumer Economics
- 608 - Community Resource Planning and Development
- 610 - Domestic Policy Analysis

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

Total number of participants (this year) 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
- 604 - Marketing and Distribution Practices

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/short survey.

When: During Fall of 2012 and Fall 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 (FOSTCO)

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, education and information dissemination needs, consumer and industry support, technology development, transfer and adaptation. Special attention is given to the issue of childhood obesity and to the improvement of public health during the pursuit of the mission. Until a critical mass of projects are developed in this latter area we will continue to plan and report here any childhood obesity research activity.

The difficult fiscal situation of the University continues to limit the progress of our Agro-Industrial Innovation and Technology Center. Still, during 2011 a faculty member was hired under a temporary contract to initiate research on food nanotechnology. Though this new faculty member has injected energy to, and opened new doors for our group, it seems that she will leave us after her contract expires. Aside from this effort, research continues to focus on adding value to Puerto Rico's specialty crops.

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%	
512	Quality Maintenance in Storing and Marketing Non-Food Products			5%	
701	Nutrient Composition of Food			15%	
702	Requirements and Function of Nutrients and Other Food Components			5%	
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 life to exist. It is the role of the agro-industry to ensure a safe and sufficient supply of nutritious food at an affordable price, while minimizing the impact on the environment. 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 the food it consumes. Traditionally, efforts of the Department of Agriculture of PR and University of Puerto Rico's College of Agricultural Sciences have focused on farm production aspects, even though several experts have suggested that PR's agricultural goods are more expensive than those of competing countries. Agricultural economists concur on the need to add value to the agricultural product as a means to revive PR's agriculture.

A recent study by a professor from Towson University in Maryland showed that 18% of PR's adolescent population areoverweight 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.

During a recent program meeting (i.e., March 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.
- Definition or evaluation of quality parameters for fresh and processed goods, including chemical properties, safety and nutritional value.
- Characterization and reutilization of harvest, slaughter or food processing wastes, residues and effluents for the development of value added goods.
- Review and promotion of simple food preservation technologies at home. (New priority)

2. Scope of the Program

- In-State Research

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

1. Assumptions made for the Program

- The high cost of manual labor on the island, compared to 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 needs to move farmers away from fresh market production and onto a community-oriented agricultural development strategy to deliver value added products.
- Should new feasible value-added product alternatives become available, Puerto Rico's farmer cooperatives and industry will embrace the new markets and exploit them.
- The establishment and habilitation of CITAI (Center for Innovation and Agro Industrial Technology), including allocation of necessary funds and human resources, will position the Program as leader in the development and adaptation of technology to improve production processes of value-added agricultural products.
- External funding will be obtained to support research and related activities of the Program.
- 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, all the while considering such aspects as food safety, nutritional value, environmental impact, education and information dissemination needs, consumer and industry support, 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
2013	0.0	0.0	4.0	0.0
2014	0.0	0.0	4.0	0.0
2015	0.0	0.0	4.0	0.0
2016	0.0	0.0	4.0	0.0
2017	0.0	0.0	4.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

• Presentations, journal articles, Extension Service publications, and other literature contributions that make research results available to users and/or that establish guidelines or recommendations for process improvement or compliance with government regulations.
• Seminars, short courses and workshops on various topics with open registration to industry and particular individuals.
• Project 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	Total Number of Enterprises Impacted by the Program.
2	Food Manufacturing Exports in million dollars
3	Food Manufacturing Imports in million dollars.
4	Number of improvement or development projects focused on safety or nutritional aspects of product or production processes
5	Number of projects on postharvest or packaging
6	Number of projects focusing on definition of quality parameters
7	Number of projects dealing with residues, wastes or effluents

Outcome # 1

1. Outcome Target

Total Number of Enterprises Impacted by the Program.

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Food Manufacturing Exports in million dollars

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Food Manufacturing Imports in million dollars.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

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 # 5

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 # 6

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 # 7

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 kind with the island, episodes of drought or intense rain are common.

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 to invest in research or new ventures will be limited. The University budget is still battling reductions and cuts.

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 worked on, 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 dedicated to the program. Instead, they belong to other departments and they need to address issues as their respective programs so require. Thus, we have a pool of researchers who are constantly entering and leaving. During 2011, we had the opportunity to add a new resource to our staff who focused on food nanotechnology. Apparently, even that resource will leave the team because of the University's inaction to consummate a new contract agreement.

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

Childhood Obesity

2. Brief summary about Planned Program

We currently have no active projects under this program. Until a critical mass of projects are developed in this area we will continue to report any research activity related to childhood obesity under our "Food Safety, Science, Technology, and Childhood Obesity Program".

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

4. Program duration : Short-Term (One year or less)

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
701	Nutrient Composition of Food			100%	
	Total			100%	

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

1. Situation and priorities

No previous research has been conducted in this field by PRAES. This may change in the future as some of our newly recruited Faculty have expressed an interest in developing more nutritional snacks for the young based on our tropical fruit crops.

2. Scope of the Program

- In-State Research

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

1. Assumptions made for the Program

Faculty of the CAS will submit projects and perform educational activities related to childhood obesity

2. Ultimate goal(s) of this Program

To achieve an improvement of childhood obesity and public healtn in Puerto Rico .

V(E). Planned Program (Inputs)

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

Year	Extension		Research	
	1862	1890	1862	1890
2013	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Calls for proposals in the area of childhood obesity will be distributed to interested faculty.

Until a critical mass of projects is available related activities will be reported under our FOSSTCO 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

Families, Extension Educators, Teachers in the Educational System, school children in general; university faculty with interests in this area.

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

☐ 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

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

Description

{NO DATA ENTERED}

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

{NO DATA ENTERED}

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Sustainable Energy

2. Brief summary about Planned Program

A new research program on "Renewable Energy Alternatives for Small Islands: Technological Solutions and Social, Physical, and Economic Constraints" was planned last year 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 are expected to culminate this year their 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 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 : New (One year or less)

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.

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 are developing 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.

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
2013	0.0	0.0	1.2	0.0
2014	0.0	0.0	1.2	0.0
2015	0.0	0.0	1.3	0.0
2016	0.0	0.0	1.3	0.0
2017	0.0	0.0	1.5	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
-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- Recession and high cost of input, may limit farmers' ability to adopt other types of technologies with long term payoffs

Appropriation changes- Availability of continued funding for research and forincentives 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 new program (of less than one year) which 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)
· 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.