2012 University of Puerto Rico Research Plan of Work

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I. Plan Overview

1. Brief Summary about Plan Of Work

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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. To advance regional goals, the AES also participates in both multistate research and Special Grants from USDA-NIFA that target agriculture in the Caribbean Basin territory of the United States.

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

Following NIFA's guidance, all planned programs were reviewed this 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. While our research program is at present principally aligned with the first two national goals, we expect that 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 alternative uses and markets for our products.

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

Rising imported food prices have, nevertheless, attracted increased public attention to Puerto Rico's fragile food security, and to the urgent need to adopt measures to protect agricultural resources and augment the output of the farm economy. While the state university system is facing budget cuts which certainly affect our overall long-term planning and ability to strengthen all research programs, additional efforts are being

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

In addition, renewed government-academia collaborations 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 two 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. Last year the pilot organic farm established in one of our agricultural experiment stations obtained its USDA certification, becoming their first certified organic operation in the island. We envision this initiative as the fulcrum of a broader effort to expand, in this location, research in sustainable agriculture, renewable energy, and agro-forestry research and education.

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 goal of increasing local and regional food security. 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 in the island. Participants in the **Food Safety, Science, Technology and Childhood Obesity** (FOSTCO) 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. While 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 FOSTCO 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. 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. 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.

While 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, program participants believe that basic climate modeling research in the tropics should also become a priority since the error margins of local assessments are reputedly very high. Thus, 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 modeling efforts and issues related to solid waste disposal 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 couple of 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 in 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 in 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.

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. Future POW revisions will attempt to tackle this problem more directly and to offer other alternatives to evaluate the progress of our programs.

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

Year	Extension		Research	
	1862	1890	1862	1890
2012	0.0	0.0	56.4	0.0
2013	0.0	0.0	55.3	0.0
2014	0.0	0.0	56.0	0.0
2015	0.0	0.0	55.8	0.0
2016	0.0	0.0	56.6	0.0

II. Merit Review Process

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

- Internal University Panel
- Expert Peer Review

2. Brief Explanation

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

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

are approved in Washington, the new or revised projects are included in the AES research program.

III. Evaluation of Multis & Joint Activities

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

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

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

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

2. How will the planned programs address the needs of under-served and under-represented populations of the 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. Therefore, the vast majority of the island's population qualifies as "under-served and under-represented" citizens in Federal government Programs. Moreover, compared with the assistance that other sectors such as manufacturing have received over the years, agriculture and rural areas in general, have lagged behind in public investment by the Commonwealth government. In this context, this POW planned programs efforts towards the enhancement of natural resources and towards the analysis and managed solution of problems affecting agriculture, with the ultimate goal of increasing the competitive production of our commodities and raise the employment level of the population, is addressing the stated needs of a critical sector and its underlying population.

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

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

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

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

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

Our stakeholders are a very diverse audience. Some of their problems are amenable to technological solutions while others are more complex, market and resource-related issues deserving further study and possibly new public policy interventions. To improve and promote integrated research and extension approaches to those areas in which we share similar goals and in which there are technological recommendations for present problems, we chose last year one program in which researchers and extension specialists were to meet periodically

and coordinate educational activities for both extension agents and producers. This pilot collaboration involves our Integrated Management of New and Emerging Pests program and Extension's Crop Protection Program. During this past year a new collaborative effort was initiated to determine the spread of citrus greening, and a working group was organized with Extension and DA officials to prepare an emergency response. We will continue monitoring the progress of this initiative and expect to implement similar collaborations in the future with other Extension programs for which wehave a research counterpart.

IV. Stakeholder Input

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

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

Brief explanation.

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

Second, commodity group leaders, program coordinators and directors of integrated academic departments will continue to organize thematic workshops, seminars, and field days where research results will be shared and the research and extension needs, or public policy determinations, will be discussed.

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

1. Method to identify individuals and groups

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

Brief explanation.

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

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

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder individuals

Brief explanation.

Input from stakeholders is collected at the meetings conducted by commodity and program leaders. Stakeholders are asked about the most critical issues affecting their commodities and localities and about our research priorities. This information is summarized in a report made by the commodity and program leaders.

3. A statement of how the input will be considered

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

Brief explanation.

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

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger - Milk and Meat Production Systems

2. Brief summary about Planned Program

Research and outreach to stakeholders under this program area are aimed at improving the on-farm efficiency (biological and economic) of the various livestock enterprises of Puerto Rico, by means of identifying recommended management practices (RMP) and achieving their adoption on producers' farms. Increased volume of livestock production, efficiency of production, and quality of the foods of animal origin offered to the consuming public are all goals of the program. Current research is directed toward improved forage production and utilization, and enhanced animal performance through better feeding, genetic selection, reproductive management, control of parasites, and prevention and treatment of other health disorders. It is also directed towards the alleviation of environmental stress and promotion of animal comfort.

Although new knowledge and advanced technologies are important concerns, we also realize that there is already a large store of existing knowledge that is not serving the purpose it should, because many local livestock producers are working inappropriately with respect to elementary husbandry practices, lacking records and animal identification of the whole herd, and making unwise financial management decisions. Thus, the least effective part of our program in the past has been too little implementation on the farm of practices of proven effectiveness. Therefore, improved outreach methods and follow-up studies to verify adoption of practices will be goals to strive toward in the years covered in this plan of work. We expect that results of our program, as they become available to and adopted by stakeholders, will make a positive contribution to the island's food security situation, while mitigating the impact that meat and milk production systems have over the environment.

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

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

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

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

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
202	Plant Genetic Resources			5%	
205	Plant Management Systems			5%	
301	Reproductive Performance of Animals			15%	
302	Nutrient Utilization in Animals			15%	
303	Genetic Improvement of Animals			15%	
305	Animal Physiological Processes			5%	
306	Environmental Stress in Animals			10%	
308	Improved Animal Products (Before Harvest)			10%	
311	Animal Diseases			5%	
313	Internal Parasites in Animals			5%	
403	Waste Disposal, Recycling, and Reuse			5%	
601	Economics of Agricultural Production and Farm Management			5%	
	Total			100%	

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

1. Situation and priorities

Given the limited institutional resources available, it is most important that our research efforts be directed toward the development of RMP with a high probability of being implemented on producers' farms. The high cost of imported concentrate feed is a matter of paramount importance for most of the local livestock industries. In the case of ruminant animals one means of mitigating this problem is the optimal use of well-managed pastures and highly nutritious conserved forages, with the notable inclusion among the latter of silage made from grain varieties of sorghum as an indirect means of achieving some local feed grain production. Sheep and goat production on the island occurs mostly in small herds; for these producers the establishment of the novel forage plants Morus alba and hibiscus on their land could help to reduce the need for supplemental feeding with concentrates. Agro industrial by products generated locally could also serve as partial substitutes for imported concentrates. Glycerol is an example of a byproduct presently produced on the island and active research on its utilization in dairy cattle rations continues.

Improvement of animal genotypes is also of obvious importance to efficient production. In beef cattle important progress has been made with the introduction to Puerto Rico of Senepol animals and with performance testing of this breed and its crosses with other beef breeds, including studies on genetic markers in these efforts. In dairy cattle the paradigm that the Holstein is the highest producing and

therefore the only dairy breed worthy of consideration, which was widely accepted for many years, is now seriously questioned. The Jersey breed is used with excellent results in other tropical countries such as Costa Rica, but the higher acid degree value of its milk would be a disadvantage under the present regulations concerning permissible milk composition in Puerto Rico. Another suggestion is a cross breeding project to produce perhaps a 5/8 Holstein X 3/8 Senepol cow population better adapted to local conditions than the Holstein and with hybrid vigor for improved reproductive performance. Such a project could be accelerated by the use of embryo transfer.

Even with animals genetically better adapted to local tropical conditions, the importance of research on environmental influences will not be lessened. Effective practices for reducing the effects of environmental stress and promoting rapid and feed efficient growth, high dressing percentage and meat quality, high yield and adequate milk composition, and good reproductive performance will still be important components of efforts to improve livestock production in Puerto Rico and will contribute to increased food security.

2. Scope of the Program

- In-State Research

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

1. Assumptions made for the Program

1. Research conducted under this Program will continue to identify and refine additional RMP for the various classes of livestock in Puerto Rico.
2. RMP of proven effectiveness and feasibility will be communicated to livestock producers by a variety of both conventional and innovative methods, including whenever possible field days on the farms of producers who have adopted certain RMP.
3. Adoption of RMP will begin with the most progressive producers who will then serve as models to gradually convince a majority, or at least an appreciable proportion, of all local producers to follow suite.
4. Milk producers who do not change their habit of feeding their herds too little forage and of poor quality and depending on heavy concentrate feeding to all cows regardless of production level, with be forced out of the dairy business in the next few years.
5. A scheme for classification of locally produced grass-fed beef, and for differentiating it from imported beef will be implemented and will result in better prices being paid to local producers.
6. Funds received from all sources will be sufficient to enable reasonable progress to be made in the research and outreach activities planned under this Program.

2. Ultimate goal(s) of this Program

To contribute to an urgently needed increased degree of food self-sufficiency and security in Puerto Rico through an increased volume of local production of foods of animal origin, including meat from bovines, small ruminants, swine, poultry and rabbits; bovine milk and chicken eggs. Also a goal of this program is to maintain or improve the quality of locally produced meat and dairy products (sanitary, nutritional and organoleptic) made available to the consuming public at affordable cost. At the same time the Program aims to improve the economic returns of livestock producers and to foster a greater impact of the production, processing and distribution of foods of animal origin on the overall economic activity of the island, including a greater number of employment opportunities.

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
2012	0.0	0.0	10.5	0.0
2013	0.0	0.0	10.5	0.0
2014	0.0	0.0	10.5	0.0
2015	0.0	0.0	10.5	0.0
2016	0.0	0.0	9.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

1. Maintain communication with members of the work groups conducting research in forages, small ruminants, beef cattle, and dairy cattle to promote these persons' endeavors and encourage them to submit for publication the results of completed experiments.
2. Continue to compile a list of RMP for each class of livestock and to characterize these practices regarding time and cost required for their implementation on producers' farms.
3. Continue work with the UCAR (Spanish initials for Quality and High Yield Unit) project to aid a selected group of forage-producing farmers to improve the nutritional value of conserved forages produced in Puerto Rico. This project has financial support from the Commonwealth Department of Agriculture.
4. Continue work on a UCAR project to promote more efficient operation of commercial beef breeder herds located in diverse parts of the island, led by a researcher and with the participation of nine Extension Service County Agents.
5. Continue operating a project with support from FFICR (Spanish initials for Fund for the Improvement of the Beef Industry) and the Puerto Rican Department of Agriculture to educate the public about the health benefits of local grass-fed beef, based on its freshness and lipid composition, relative to that of imported feedlot beef, and to promote consumer demand for local meat.
6. Continue to produce and distribute the serial extension-type publication "La Res Informativa" for beef cattle producers.
7. Organize field days and training sessions through which livestock producers acquire pertinent knowledge and skills with emphasis on witnessing RMP in action on producers' farms.

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

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

(1)Commercial-scale producers of the following types of livestock and related products: bovine milk and replacement dairy cattle, beef cattle, sheep and goats, swine, rabbits, poultry for meat and eggs, and forages for sale.
(2)Specialists and County Agents of the Agricultural Extension Service of UPR.
(3) Professional personnel of the Puerto Rican Department of Agriculture and of the USDA.
(4) Policy makers in the Commonwealth and Federal Governments.
(5) Personnel of the Farm Credit Service and other financial institutions that make loans to livestock producers.
(6) Professionals engaged in private enterprises such as consulting services.
(7) Faculty members and university graduate and undergraduate students.
(8) High school students of vocational agriculture.
(9) Interested members from the general public.

V(G). Planned Program (Outputs)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0

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

2012:0 **2013:**0 **2014:**0 **2015:**0 **2016:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2012	7	0	7
2013	8	0	8
2014	8	0	8
2015	8	0	8
2016	10	0	10

V(H). State Defined Outputs

1. Output Target

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

2012:6	**2013:**6	**2014:**6	**2015:**6	**2016:**6

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

2012:5	**2013:**5	**2014:**5	**2015:**5	**2016:**5

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

2012:6	**2013:**6	**2014:**6	**2015:**6	**2016:**6

- Number of publications in refereed scientific journals.

2012:8	**2013:**8	**2014:**9	**2015:**9	**2016:**10

V(I). State Defined Outcome

O. No	Outcome Name
1	Number of participants 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 participants in field days willing to adopt the RMPs demonstrated.

2. Outcome Type : Change in Knowledge Outcome Measure

2012:36	**2013:**36	**2014:**36	**2015:**36	**2016:**40

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

2012:14	**2013:**103	**2014:**106	**2015:**109	**2016:**112

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, Food)

Description

Natural Disasters (Weather patterns) - 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 the lands 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- Costs of 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. Unforeseeable future trends in the costs of many of these items could have a big influence on local livestock industries.

Competition from imports- 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.

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.

Appropriations changes- Public finances and UPR 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.

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, 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 will 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.

Food habits- 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 (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Other (Follow-up on Implementation)

Description

RMP will be communicated to livestock producers by all types of outreach activities, but with emphasis on demonstrating them on field days or in training sessions, preferably on producers' farms, where their practicality will be most convincing. At these events producers in attendance will be requested to complete a short questionnaire whereby they indicate their degree of interest in adopting the RMP demonstrated, by choosing among the options: (A) none, (B) minimum, (C) moderate, and (D) considerable. Producers selecting option D will receive further encouragement and any needed aid to implement the RMP on their farms from Extension Service personnel. Those choosing option C will be listed as candidates for further educational efforts and for continued contact with the aim of possible future acceptance of the RMP. The culmination of these research activities will be verification that the RMP is in use on the producer's farm.

2. Data Collection Methods

- On-Site
- Unstructured
- Observation

Description

The planned program will use qualitative methods and a simple evaluation form to collect data from prospective adopters of RMP at events such as field days and training sessions designed to demonstrate the specific practices.

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

As a result of improved access to rapid diagnostic tests and surveillance, Asian soybean rust (ASR) caused by Phakopsora pachyrrhizi was identified in the northwest of the island in winter nurseries. The increased efforts in the surveillance of ASR has been important for early detection and eradication of the infected plots. In the southwest of the island, increased precipitation during the summer months of 2010 resulted in the death of papaya tree plantations; waterlogged areas caused severe decline of trees because of Phytophthorapalmivora. Another new disease identified is black leaf spot of papaya caused by Asperisporium caricae. Understanding the climate factors influencing these outbreaks will aid in the identification of sustainable agricultural practices and prevent the spread of the disease to major production areas. An outbreak of Ralstonia solanacearum race 1 was identified with 100% losses. Predictions of disease outbreaks have been more difficult in unstable weather and plans are to continue with surveillance of exotic diseases to prevent their spread.

AES intensified pest surveillance that resulted in the identification of Lobate lac scale,Paratachardina pseudolobata in Garcinia intermedia and Pine Tortoise Scale, Toumeyella parvicornis identified inPinus. Haplaxius crudus, the palm cixiid, a potentially damaging pest of palms, was first identified during 2010. This pest is a known vector of palm lethal yellowing phytoplasma. Surveillance for the appearance of this disease is paramount. Plans are to continue to design research for alternative control practices for the recently identified diseases and pests, including "citrus greening", vectored by the citrus psyllid. Coffee berry borer is causing losses, andBeauveria bassiana is still the most promising fungus for biological control. Activities for the resistance management program against Lepidopterous pests in horticultural crops in Puerto Rico focused on natural enemies conservation and pesticide selection principles to lessen the economic impact of Helicoverpa zea. We will deliver strategic insights to improve research plans and growers' awareness and involvement for the possible effects of climate change in pest and disease behavior

Six predaceous coleoptera species have been identified in association with the Harrisia cactus mealybug. A two year study of the dynamics of the phytophagous mite Raoiella indica (Tenuipalpidae) showed that Amblyseis largoensis (Muma) is the main predator species associated with this pest in Puerto Rico. PRAES will disseminate the Strategic Management Plan for Black Sigatoka with effective fungicides. Advances in the identification and emergence of powdery mildew (PM) fungi will continue with supplemental electron microscopy (SEM) and phylogenetic analyses to find evidence of new PM species in Puerto Rico. Finally, a new emphasis will be placed on the potential effects of climate change on pest and disease dynamics in the tropics. A working group will be established this year to design an analysis and implementation plan that will lead to the incorporation of climate change into the IMNE program.

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			16%	
212	Pathogens and Nematodes Affecting Plants			23%	
215	Biological Control of Pests Affecting Plants			32%	
216	Integrated Pest Management Systems			29%	
	Total			100%	

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

1. Situation and priorities

AES Extension and research program addresses the development and dissemination of IPM practices directed to a sustainable production system. Priorities include understanding the dynamics of pests, and the etiology of diseases, addressing five focus areas: (1) improvement of methods for new and emergent pest and disease identification; (2) improvement of crop protection through cultivar selection; (3) use of reduced risk practices and vector and pathogen management; (4) selection of biological control agents for major pests affecting important crops; and (5) generation of applicable information and appropriate development of dissemination tools and their effective implementation. Toward those goals we will continue with better diagnostic and identification methods of diseases and pest detection and identification, using molecular techniques. The search for cultivars with disease tolerance will be accomplished through collaboration with the breeding programs. We will continue with studies of new and emerging threats in order to identify sustainable management options.

AES has improved access to rapid diagnostic tests and surveillance methods for pests and diseases; these have resulted in the detection and identification of three new exotic diseases and two pest introductions in Puerto Rico. The increased efforts in the surveillance of Asian soybean rust have been important for early detection and eradication of the infected plots. New priorities will address research in management and prevention of newly identified emergent diseases and will intensify pest surveillance. We will also deliver strategic insights to improve research plans and growers' awareness of the possible effects of climate change in pest and disease behavior. AES will continue the search for potential predators for different pests. Also planned is the development of recommendations for high risk areas to detect and monitor potentially invasive species based on the aggregate information; and from this information an assessment of the feasibility of establishing a fruit-fly-free zone in Puerto Rico.

AES designed a Strategic Management Plant for Black Sigatoka after evaluating systemic and

contact fungicides. A total of 17 Musae spp. clonal hybrid selections were also evaluated for resistance to Black Sigatoka. The accessions selected are at the USDA-TARS germplasm collection and are available for distribution. AES will continue to study emerging diseases, such as powdery mildew, that are severely affecting mangoes, tomatoes, ornamentals, herbs, cucurbits and legumes. Organic farmers are the ones most affected by severe powdery mildew outbreaks. Research focusing in their identification beyond the generic Oidium concept, and their biodiversity is fundamental. Advances in the identification and emergence of powdery mildew fungi will continue with supplemental electron microscopy (SEM) and phylogenetic analyses to find evidence of new introductions in Puerto Rico. These findings will lead to better recommendations for disease control.

2. Scope of the Program

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

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

1. Assumptions made for the Program

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

2. Ultimate goal(s) of this Program

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

• To intensify pest surveillance in order to prevent disease and pest outbreaks.

• To 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
2012	0.0	0.0	14.1	0.0
2013	0.0	0.0	13.0	0.0
2014	0.0	0.0	13.0	0.0
2015	0.0	0.0	12.0	0.0
2016	0.0	0.0	12.0	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 improved methods to control vectors of pathogens.
- Foster the use of cutting-edge technology to implement IPM.
- Enhance our capacity to conduct fast pest and disease diagnoses.
- Conduct research on 'reduced risk' pesticides.
- Greater integration of Outreach and Extension.
- Greater understanding of the needs and expectations of stakeholders and establishment of collaborative partnerships wiith stakeholders
- Develop effective disease and pest management strategies compatible with a sustainable food production system in Puerto Rico.
- Disseminate research results through publications, seminars, field days, conferences, and any other method deemed appropriate to reach our target audiences: extension specialists and agents, government partners, students, producers, consumers and environmental organizations

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

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

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

V(G). Planned Program (Outputs)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0

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

2012:0 **2013:**0 **2014:**0 **2015:**0 **2016:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2012	7	0	0
2013	9	0	0
2014	10	0	0
2015	10	0	0
2016	10	0	0

V(H). State Defined Outputs

1. Output Target

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

2012:3 **2013:**3 **2014:**3 **2015:**3 **2016:**3

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

2012:5 **2013:**5 **2014:**5 **2015:**5 **2016:**5

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

2012:15 **2013:**15 **2014:**15 **2015:**15 **2016:**20

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

2012:15 **2013:**15 **2014:**15 **2015:**15 **2016:**20

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

2012:15 **2013:**15 **2014:**15 **2015:**15 **2016:**20

- 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.

2012:5 **2013:**5 **2014:**5 **2015:**5 **2016:**15

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

2012:5 **2013:**5 **2014:**5 **2015:**5 **2016:**8

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

2012:100	**2013:**120	**2014:**150	**2015:**250	**2016:**250

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Number of persons who adopted reduced risk pesticides and practices

2. Outcome Type : Change in Action Outcome Measure

2012:50	**2013:**50	**2014:**100	**2015:**250	**2016:**250

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

2012:60	**2013:**60	**2014:**100	**2015:**100	**2016:**200

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

2012:100	**2013:**100	**2014:**200	**2015:**200	**2016:**200

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

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

1. Evaluation Studies Planned

- Other (Yearly baseline indicators)

Description

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

2. Data Collection Methods

- On-Site
- Case Study

Description

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

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

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. 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 address specific problems such as Black Sigatoka of bananas and plantains. Program researchers plan to recover germplasm of traditional crops from US repositories, introduce new fruits and starchy crops varieties, and run performance tests under PR conditions.

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.

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 specificproduction 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.

• 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 PRAES breeding program.

2. Scope of the Program

- In-State Research
- Multistate Research

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

1. Assumptions made for the Program

• The maintenance of adequate long-term financial support for research to permit plant-breeding programs to develop improved cultivars, and to permit researchers to develop and to update recommended production practices.

• The availability of scientists with the expertise needed to develop crop cultivars, to maintain genetic germplasm and to conduct crop production research

• The continuation of a seed program that will insure the availability of seed for improved cultivars of traditional crops.

• Extreme weather conditions will not destroy field trials, germplasm collections or infrastructure needed to conduct research.

2. Ultimate goal(s) of this Program

To achieve wide-scale adoption of improved cultivars and 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
2012	0.0	0.0	17.0	0.0
2013	0.0	0.0	17.0	0.0
2014	0.0	0.0	17.0	0.0
2015	0.0	0.0	17.0	0.0

Year	Extension		Research	
	1862	1890	1862	1890
2016	0.0	0.0	17.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

• Development and release of improved cultivars of crops of economic importancesuch as beans, sweet corn, tanier, sweet potato, pigeon pea, tropical pumpkins, and sweet cherry pepper.
• Introduce and evaluate the performance of starchy crops such as cassava and tropical yams, and fruit crops such as guava and breadfruit.
• Electronic publication of descriptions of germplasm collections
• Distribution of germplasm to scientists and to the public
• Publication of technology packages describing best management practices for crops of economic importance
• In collaboration with the Agricultural Extension Service, host field days for stakeholders at different PRAES Substations .
• Increased on-farm research to validate new technology
• Publication of research results in bulletins and local newspapers for farmers and in refereed journals for scientists.
• Presentations of research results at scientific meetings.
• Collect information from stakeholders on critical issues of importance to this program.This information will help to establish future research priorities.

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)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0

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

2012:0 **2013:**0 **2014:**0 **2015:**0 **2016:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2012	5	0	5
2013	5	0	5
2014	8	0	8
2015	9	0	9
2016	10	0	10

V(H). State Defined Outputs

1. Output Target

- Number of farmers planting newly released varieties developed by PRAES.

2012:125 **2013:**125 **2014:**125 **2015:**125 **2016:**125

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

2012:1 **2013:**1 **2014:**1 **2015:**1 **2016:**1

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

2012:1700 **2013:**1700 **2014:**1700 **2015:**1700 **2016:**1700

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

2012:260 **2013:**260 **2014:**260 **2015:**260 **2016:**260

- Number of participants in the field days coordinated with Extension

2012:135 **2013:**135 **2014:**135 **2015:**150 **2016:**160

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

2012:135 **2013:**135 **2014:**135 **2015:**135 **2016:**135

- Number of refereed publications.

2012:5 **2013:**5 **2014:**8 **2015:**9 **2016:**10

- Number of non-refereed publications.

2012:10 **2013:**11 **2014:**12 **2015:**14 **2016:**15

- Number of presentations in scientific meetings.

2012:10 **2013:**10 **2014:**11 **2015:**12 **2016:**15

- Number of research proposals submitted addressing Global Food security and hunger.

2012:2 **2013:**2 **2014:**3 **2015:**4 **2016:**5

- Number of MS Thesis related to Global Food security and hunger.

2012:2 **2013:**2 **2014:**3 **2015:**4 **2016:**5

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.

Outcome # 1

1. Outcome Target

Number of stakeholders to adopt the proposed BMPs.

2. Outcome Type : Change in Action Outcome Measure

2012:	**2013:**	**2014:**	**2015:**	**2016:**
125	125	125	125	125

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

2012:	**2013:**	**2014:**	**2015:**	**2016:**
120	125	125	125	125

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Percentage of locally produced food.

2. Outcome Type : Change in Knowledge Outcome Measure

2012:15	**2013:**15	**2014:**18	**2015:**20	**2016:**25

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

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 (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- During (during program)

Description

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

2. Data Collection Methods

- Other (Focus groups)

Description

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

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Climate Change: Natural Resources and Environment

2. Brief summary about Planned Program

The principal goal of the revised 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 management practices for efficient use of water and conservation practices; (3) studying the impact of aquatic weeds and management practices on agricultural water systems;and (4) supporting biological diversity research (particularlythe effects of non-native species on biodiversity; on management approaches for conserving and restoring biodiversity; and on the impact of agricultural management practices on natural ecosystems). In order to setup new research projects in the field of climate change, our program has been expanded to include (5) implementing strategies for sustainable neotropical ecosystems use and management to the context of climate change.

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 agricultural 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 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. 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 technology and 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
102	Soil, Plant, Water, Nutrient Relationships			16%	
111	Conservation and Efficient Use of Water			5%	
112	Watershed Protection and Management			13%	
122	Management and Control of Forest and Range Fires			6%	
123	Management and Sustainability of Forest Resources			6%	
133	Pollution Prevention and Mitigation			29%	
136	Conservation of Biological Diversity			7%	
211	Insects, Mites, and Other Arthropods Affecting Plants			1%	
213	Weeds Affecting Plants			1%	
216	Integrated Pest Management Systems			6%	
403	Waste Disposal, Recycling, and Reuse			3%	
404	Instrumentation and Control Systems			2%	
405	Drainage and Irrigation Systems and Facilities			5%	
	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.

The most active agricultural area of Puerto Rico is the southern semiarid region. Farming activities and urban development in the region are reducing the aquifers and causing salt intrusion from the sea. This situation can result in agricultural and community water issues (both quality and quantity). Research will contribute to a much efficient water use for crop production in this region.

The introduction of non-native species to both natural and agricultural ecosystems represents a serious threat to biodiversity, wildlife habitat, and agricultural production. This phenomenon is particularly devastating to fragile island ecosystems like those of Puerto Rico. 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 the island ecosystems.

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

Emerging research needs, as identified by PR-AES stakeholders and researchers for 2010-2011 are:

Knowledge Area
Research Need/Concern

101
Appraisal of Soil Resources

- Appraisal of how soils behave under different levels of management and use
- Use of remote sensing technologies for the identification of highly productive and potential agricultural lands

111
Conservation and Efficient Use of Water

- Improved water conservation practices
- Development of hydrologic sustainability indicator for agricultural use
- Studies or activities designed to control pheatophytes and aquatic weeds to reduce the damage or losses they cause

131
Alternative Uses of Land

- Conservation and management practices of agricultural land

133
Pollution Prevention and Mitigation

- Role and use of living organisms in removing pollutants from the environment
- Methods for monitoring water and soil for pollutants
- Impact of aquatic weeds and management practices on agricultural water systems

136
Conservation of Biological Diversity

- Effects of non-native species on biodiversity
- Management approaches for conserving and restoring biodiversity
- Impact of agricultural management practices on natural ecosystems
- Management approaches for protecting and conserving natural ecosystems from agricultural management practices

2. Scope of the Program

- In-State Research
- Multistate Research

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

1. Assumptions made for the Program

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

2. Ultimate goal(s) of this Program

As part of this program area we will work with the ultimate goal of improving stakeholders' management of agricultural practices ensuring both economic and resource sustainability; protecting and enhancing the island's, biodiversity, soil, forest, and water resources in concert with agricultural 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 in order to increase the adoption of technologies and systems that protect and enhance natural resources; increasing adoption of agricultural production systems to improve farm profitability and environmental quality, and engaging communities in protecting and conserving the island's natural resources; and developing long-term, sustainable, economically and environmentally sound crop production systems to protect and enhance natural ecosystems. Soil management research regarding the impact on the environment of nutrient losses in runoff from tropical agroecosystems promotes a long-term sustainable system of crop production by identifying and developing management practices that will be implemented 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.

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
2012	0.0	0.0	9.5	0.0
2013	0.0	0.0	9.5	0.0
2014	0.0	0.0	10.0	0.0
2015	0.0	0.0	10.2	0.0
2016	0.0	0.0	10.8	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

1. 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;(2) the development of management practices for efficient use of water and conservation practices; (3) the study of the impact of aquatic weeds and management practices on agricultural water systems and (4) biological diversity research(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).

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

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

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

5. 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)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0

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

2012:0 **2013:**0 **2014:**0 **2015:**0 **2016:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2012	6	0	6
2013	6	0	6
2014	7	0	7
2015	7	0	7
2016	8	0	8

V(H). State Defined Outputs

1. Output Target

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

  2012:10 **2013:**10 **2014:**10 **2015:**10 **2016:**10

- Number of Peer Reviewed publications.

  2012:6 **2013:**6 **2014:**7 **2015:**7 **2016:**8

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

  2012:2 **2013:**2 **2014:**4 **2015:**4 **2016:**6

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

  2012:2 **2013:**2 **2014:**2 **2015:**2 **2016:**2

V(I). State Defined Outcome

O. No	Outcome Name
1	Number of stakeholders gaining knowledge on natural resources enhancement, dry forest ecology and management, microirrigation scheduling, and other soil enhancement and water conservation practices
2	Number of farmers adopting microirrigation management practices
3	Number of persons adopting practices that prevent biodiversity threats and losses.
4	Number of farmers adopting methods to increase soil organic matter content
5	Number of farmers reporting increased water use efficiency in their farms
6	Number of farmers that adopted practices to improve water resources.
7	Number of watersheds for which Total Maximum Daily Load (TMDL) for nutrients have been developed.
8	Number of stakeholders gaining knowledge on organic agricultural practices.
9	Number of persons gaining knowledge effects of non-native species on biodiversity.

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

2012:100	**2013:**100	**2014:**50	**2015:**50	**2016:**20

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

2012:20	**2013:**20	**2014:**20	**2015:**20	**2016:**20

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

2012:20	**2013:**20	**2014:**20	**2015:**20	**2016:**20

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

2012:20	**2013:**20	**2014:**20	**2015:**20	**2016:**20

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

2012:20	**2013:**20	**2014:**20	**2015:**20	**2016:**20

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

2012:20	**2013:**20	**2014:**20	**2015:**20	**2016:**20

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

2. Outcome Type : Change in Knowledge Outcome Measure

2012:0	**2013:**0	**2014:**0	**2015:**0	**2016:**0

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 8

1. Outcome Target

Number of stakeholders gaining knowledge on organic agricultural practices.

2. Outcome Type : Change in Knowledge Outcome Measure

2012:100	**2013:**100	**2014:**100	**2015:**100	**2016:**100

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 # 9

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

2012:100	**2013:**100	**2014:**100	**2015:**100	**2016:**100

3. Associated Knowledge Area(s)

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 (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Other (stakeholders interviews)

Description

2. Data Collection Methods

- On-Site
- Unstructured
- Observation

Description

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 (PR), coupled with the reduced ability of the government to provide increased incentives or subsidies to these sectors because of a current and prospective fiscal crises, 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 promising new 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 resources 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 Puerto Rico 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. Although some important benefits have been attained, other problem areas have emerged that threaten the food security status of the island's population. 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 local 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 make the best food consumption decisions, particularly with regards to the long term health impact. 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 vulnerability of Puerto Rico'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 studies 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 to meet newly established Federal research priorities. In particular, it has been reframed mainly to meet the food security priority.

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 Puerto Rican producers and intermediaries that improve market access for producers and that 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 Rican producers.

Identification and adoption of improved institutional arrangements by Puerto Rican rural communities that allow their members to effectively (i) benefit from all the other objectives stated here, as well as (ii) to 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
2012	0.0	0.0	2.0	0.0
2013	0.0	0.0	2.0	0.0
2014	0.0	0.0	2.0	0.0
2015	0.0	0.0	2.3	0.0
2016	0.0	0.0	2.8	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

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 which local food system stakeholders are currently using or might use to create and manage ongoing or potential change, and 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)

1. Standard output measures

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

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2016	0	0	0	0

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

2012:0 **2013:**0 **2014:**0 **2015:**0 **2016:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2012	3	0	3
2013	3	0	3
2014	3	0	3
2015	3	0	3
2016	3	0	3

V(H). State Defined Outputs

1. Output Target

- Number of refereed publications

  2012:3 **2013:**3 **2014:**3 **2015:**3 **2016:**3

- Number of presentations in scientific meetings

  2012:5 **2013:**5 **2014:**5 **2015:**5 **2016:**5

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

  2012:7 **2013:**8 **2014:**6 **2015:**6 **2016:**6

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

  2012:185 **2013:**195 **2014:**141 **2015:**195 **2016:**160

V(I). State Defined Outcome

O. No	Outcome Name
1	Number of stakeholders gaining knowledge about new production management or marketing tools (medium-term measure)
2	Number of stakeholders gaining knowledge about public policy issues relevant to local agriculture and natural resources.

Outcome # 1

1. Outcome Target

Number of stakeholders gaining knowledge about new production management or marketing tools (medium-term measure)

2. Outcome Type : Change in Knowledge Outcome Measure

2012:500	**2013:**500	**2014:**500	**2015:**500	**2016:**500

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

2012:100	**2013:**100	**2014:**100	**2015:**100	**2016:**100

3. Associated Knowledge Area(s)

- 608 - Community Resource Planning and Development
- 610 - Domestic Policy Analysis

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 (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Other (Focus group)

Description

A focus group will be conducted later this year with representatives of program stakeholders to evaluate progress to date and changes that may be implemented to achieve outcomes.

2. Data Collection Methods

- Other (Focus group)

Description

Later this year, a focus group with representatives of program stakeholders will be convened to evaluate progress to date and changes that may be implemented to achieve outcomes.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

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

2. Brief summary about Planned Program

The mission of the FOSTCO 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. Childhood obesity, which was not specifically targeted in our original POW submission, is now incorporated into this program as some of our newly recruited Faculty have expressed an interest in research and development of more nutritional snacks for the young, based on our tropical crops. Until a critical mass of projects are developed in this area we will continue to report here any childhood obesity research activity.

The difficult budget situation of the University has somewhat hampered the projected progress in our new Center for Agro-Industrial Technology and Innovation, but most of the previously acquired equipment is now installed and operational. In terms of human resources, the program has benefited from two new faculty members with expertise in nutritional and functional aspects of foods, and in food processing technologies for fruits and vegetables. Formula funds have provided initial research resources to start developing our program, but we remain committed to acquiring additional external funding to fulfill our objectives. Current research under this program is focused in adding value to Puerto Rico's specialty crops to strengthen both these commodities' future outlook and their contribution to local social and economic well-being.

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

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

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

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

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies			20%	
502	New and Improved Food Products			20%	
503	Quality Maintenance in Storing and Marketing Food Products			25%	
504	Home and Commercial Food Service			20%	
701	Nutrient Composition of Food			10%	
702	Requirements and Function of Nutrients and Other Food Components			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. Fulfilling such a role requires agro-industry to negotiate its own objectives along with consumer demands, governmental regulations and market push towards the implementation of quality management systems.

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

In contrast with the need to implement controls and systems that necessarily increase costs, there are consumer pressures for affordable and nutritious foods. Furthermore, current consumer trends in the food industry demanda wide array of gourmet flavors inconvenient sizes and withadded functionality. During recent meetings, the program priorities were slightly modified to read as follows:

- Market diversification through the development of products and processes to add value to agricultural goods, in a way that ensures their safety and nutritional value forthe consumers.
- Market strengthening through the development or adaptation of postharvest and packaging technology and practices to maintain the safety and quality of agricultural goods in the supply chain.
- Definition or evaluation of quality parameters for fresh and processed goods, including 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.

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 must 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 of CITAI (Center for Innovation and Agro industrial Technology), including allocation of necessary funds and human resources, will position the Program to lead in the 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.

2. Ultimate goal(s) of this Program

Promote the viability of the agro-industrial sector and the general quality of life by continuous process-improvement of food and non-food products, current or new, and their respective manufacturing processes. This promotionincludes such aspects as food safety throughout the production and supply chain, nutritional value, packagingand transport.

Contribute to the general well-being of the population through healthier snacks and meal options which incorporate local products.

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
2012	0.0	0.0	2.5	0.0
2013	0.0	0.0	2.5	0.0
2014	0.0	0.0	2.8	0.0
2015	0.0	0.0	2.8	0.0

Year	Extension		Research	
	1862	1890	1862	1890
2016	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 results available to users, and/or thatestablish guidelines or recommendationsfor process improvement or compliance with government regulations.
- Seminars, short courses and workshops on various topics with open registration forindustry and individuals.
- Project collaborations with industriesto research specific issues affecting their productsor processes.

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

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

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

V(G). Planned Program (Outputs)

1. Standard output measures

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

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2015	0	0	0	0
2016	0	0	0	0

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

2012:0 **2013:**0 **2014:**0 **2015:**0 **2016:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2012	4	0	4
2013	5	0	5
2014	5	0	5
2015	7	0	7
2016	6	0	6

V(H). State Defined Outputs

1. Output Target

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

2012:4 **2013:**4 **2014:**8 **2015:**8 **2016:**8

- Number of projects or industry collaboration agreements established

2012:2 **2013:**4 **2014:**4 **2015:**4 **2016:**4

V(I). State Defined Outcome

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

Outcome # 1

1. Outcome Target

Total Number of Enterprises Impacted by the Program.

2. Outcome Type : Change in Knowledge Outcome Measure

2012:40	**2013:**45	**2014:**50	**2015:**60	**2016:**60

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

Food Manufacturing Exports in million dollars

2. Outcome Type : Change in Action Outcome Measure

2012:5000	**2013:**5400	**2014:**5400	**2015:**5500	**2016:**5500

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

Food Manufacturing Imports in million dollars.

2. Outcome Type : Change in Condition Outcome Measure

2012:3000	**2013:**3000	**2014:**3000	**2015:**3000	**2016:**3000

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Public Policy changes
- Government Regulations
- Competing Programmatic Challenges

Description

Economy - Puerto Rico is currently suffering an economic recession. While the recession prevails, the amount of funding available to invest in research or new ventures will be limited. At the University of Puerto Rico drastic measures have been taken to adapt programs to severe budget reductions. These actions have affected funding available for travel and acquisition of materials needed to seek external funding and establish industrialcollaborations.

Public policy - The agricultural sector is highly susceptible to changes in public policy as dictated by the local Department of Agriculture. New government strategies are attempting to strengthen the links between the Department of Agriculture and the College of Agricultural Sciences of the University of Puerto Rico. It is not yet clear whetherthis collaboration will translate into additional resources for this program.

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 - Collaborating faculty members arenot solely dedicated to this program. They must address other issues as required by their respective departments. Thus, we have a pool of researchers periodically changing.

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

1. Evaluation Studies Planned

- Other (Semi-annual meetings)

Description

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

2. Data Collection Methods

- Other ()

Description

{NO DATA ENTERED}

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 : New (One year or less)

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 : No

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

{NO DATA ENTERED}

2. Ultimate goal(s) of this Program

{NO DATA ENTERED}

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
2012	0.0	0.0	0.0	0.0
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

V(F). Planned Program (Activity)

1. Activity for the Program

{NO DATA ENTERED}

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

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

{NO DATA ENTERED}

V(G). Planned Program (Outputs)

1. Standard output measures

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

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2016	0	0	0	0

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

2012:0 **2013:**0 **2014:**0 **2015:**0 **2016:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	0	0

V(H). State Defined Outputs

1. Output Target

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 (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

Description

{NO DATA ENTERED}

2. Data Collection Methods

Description

{NO DATA ENTERED}

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Sustainable Energy - Renewable Energy Alternatives for Small Islands

2. Brief summary about Planned Program

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Following NIFA guidelines on the need to tackle important agricultural issues and constraints facing our society, a new research program on "Renewable Energy Alternatives for Small Islands: Technological Solutions and Social, Physical, and Economic Constraints" is being planned in Puerto Rico. At present only a couple of projects are active in this area, but this may change in the future if financial resources are available for this type of research and development initiatives. In the long term this program aims at achieving greater energy efficiency and reducing the operating costs of farming and of agroindustrial operations in 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
402	Engineering Systems and Equipment			50%	
403	Waste Disposal, Recycling, and Reuse			50%	
	Total			100%	

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

1. Situation and priorities

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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 in the island is one of the factors contributing to the high production costs faced by agroindustries in Puerto Rico, 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. Significant results were obtained which could have been important for the development of a biofuel industry based on this crop and on alternative tropical grass species as supplemental biomass sources. The demise of sugar production in 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 to the study of their consequences and constraints. The PRAES, in partnership with the Department of Agriculture of Puerto Rico, have 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 have recently 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. Thus, while at present we do not have the critical mass of projects and resources to develop a full program, this plan outlines the direction of our efforts in this field.

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

-Determining cost effectiveness of biodiesel producing bioreactors fueled with different types of wastes
- Determining cost effectiveness of photovoltaic cells for different types of agricultural operations, and
-Identifying and evaluating alternative, non-food crops for biofuel production, with the potential of becoming a new starting point for a biofuel industry in 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

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(1) Continued funding for research projects in the area of sustainable energy will be available either from local or external sources.
(2) Government incentives for adoption of technologies will be available.
(3) Relevant expertise for conducting this type of research will continue to be available in the CAS and in the College of Engineering.
(4) After educational activities are conducted in collaboration with Extension Service, farmers will be convinced that adopting the suggested technologies is important for the success of their operation.

2. Ultimate goal(s) of this Program

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To achieve greater energy efficiency and reduce the operating costs of farming and of agroindustrial operations in 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
2012	0.0	0.0	0.8	0.0
2013	0.0	0.0	0.8	0.0
2014	0.0	0.0	0.8	0.0
2015	0.0	0.0	1.0	0.0
2016	0.0	0.0	1.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

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(1) Data collection activities on energy consumption on different types of agricultural operations
(2) Viability studies of different types of alternative energy solutions, tailored to the conditions of farming operations in Puerto Rico
(3) Technological studies of energy generation from agricultural wastes
(4) Dissemination of results to the scientific community and to farmers, government

officials, and other interested stakeholders through publications adapted to the audience

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

Extension

Direct Methods	Indirect Methods

3. Description of targeted audience

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(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.

V(G). Planned Program (Outputs)

1. Standard output measures

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

	Direct Contact Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Year	Target	Target	Target	Target
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0

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

2012:0 **2013:**0 **2014:**0 **2015:**0 **2016:**0

3. Expected Peer Review Publications

Year	Research Target	Extension Target	Total
2012	0	0	0
2013	0	0	0
2014	1	0	0
2015	2	0	0
2016	2	0	0

V(H). State Defined Outputs

1. Output Target

- Number of active research projects in the program

  2012:2 **2013:**2 **2014:**2 **2015:**3 **2016:**3

- Number of new proposals submitted targeting the program's priorities

  2012:1 **2013:**2 **2014:**2 **2015:**2 **2016:**2

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

  2012:1 **2013:**2 **2014:**3 **2015:**3 **2016:**3

- Number of meetings held with stakeholders to extend results and technologies

  2012:0 **2013:**1 **2014:**1 **2015:**2 **2016:**2

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

2012:0	**2013:**20	**2014:**25	**2015:**40	**2016:**50

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

2012:0	**2013:**0	**2014:**2	**2015:**3	**2016:**4

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

2012:0	**2013:**0	**2014:**2	**2015:**4	**2016:**8

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 inputs, may limit farmers' ability to adopt other type of technologies with long term payoffs

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

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

1. Evaluation Studies Planned

Description

{NO DATA ENTERED}

2. Data Collection Methods

Description

{NO DATA ENTERED}