

University of Puerto Rico Mayaguez Campus Combined Research and Extension Plan of Work 2021-2025

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I. Plan Overview

1. Executive Summary

This five-year plan of work (POW) covers the period from October 1, 2020 to September 30, 2025. It has been prepared through a collaboration between the Puerto Rico Agricultural Experiment Station (PRAEX) and the Puerto Rico Agricultural Extension Service (PRAES). The current POW updates show minor changes from last year's plans. We will continue focusing in the following six (6) previously identified critical issues (1) Food Security, Plant & Animal Systems; (2) Extreme Weather, Natural Resources and Environment, and Sustainable Energy; (3) Food Safety, Science and Technology; (4) Community, Economy, and Sustainable Development; (5) Family Well-Being; and (6) Positive Youth Development. The first four critical issues were jointly planned between both units while the last two are exclusively part of PRAES programming.

These critical issues were defined taking into account the priorities set by our programs' stakeholders and the outcomes of Merit Review meetings as well as discussions held with collaborators from government and non-government agencies. PRAES State Program Area Leaders were consulted as were the specialists who assist in the preparation of reports on our work plan and accomplishments. Information was also gathered from local Agricultural Agents and Family and Consumer Science Educators who are in close contact with farmers, homeowners, housewives, youth and community leaders. After the experiences of Hurricane Maria, recent earthquakes and now, the COVID-19 pandemic, there is general agreement to strengthen our educational effort on natural disaster preparedness and biosecurity measurements through all Extension programs. PRAEX stakeholders also deemed prioritizing research efforts that help to improve the island's food security and the resiliency of our natural and socioeconomic systems.

FOOD SECURITY, PLANT AND ANIMAL SYSTEMS

This critical issue covers crop and animal production, as well as pest management to ensure sustainability in food security. Puerto Rico produces less than 20 percent of the food it consumes, with 56% of the imported food coming from the United States. Local agricultural systems face environmental and socio-economic challenges that, if not adequately addressed, will disrupt the balance among farm profitability, farm sustainability and food security. Research and Extension have and will focus efforts on seeking improvement in biological efficiency of crop and livestock.

Puerto Rico's 2017 gross agricultural income generated \$880,278 million comprising 45% from animal production and 44% from crop production. In order of economic relevance, the sectors in animal production that contributed the most were dairy cattle, poultry, beef cattle, swine, bees, fish and other aquaculture, other meats (rabbits, goats and sheep) and dairy goats. Crop production is led by starchy crops such as plantains and bananas, followed by vegetables, fruits and coffee.

Research and Extension personnel will continue their efforts to increase local food availability by farm production and urban agriculture. To increase food accessibility, feasibility analysis, marketing studies and the establishment of market networks among farmers and food chain distribution members are needed. Extension's Family and Consumer Science specialists will continue promoting the importance of consuming nutritious meals, safe food handling, food preparation and promoting healthy lifestyles. In order to strengthen the food system, research and extension personnel will continue to study and promote adaptation strategies for resilient agricultural production, post-harvest crop management and improved marketing efficiency.

Local urban agriculture is primarily related to vegetable production. Vegetables are important cash crops for the local farmers' markets and as exports to the US during the winter season. Limitations for vegetable production are associated with the lack of seed availability and disease resistant varieties for local production. In addition, there is limited information

on sustainable soil management practices to alleviate soil fertility problems. The limitations and the high cost of inputs have forced a significant number of farmers to abandon their farming operations.

The evaluation of new varieties of lettuce, tropical pumpkin, sweet pepper and tomatoes, resulted in recommendations for adapted cultivars to the local environmental conditions. Educational methods such as field days, workshops, short courses, webinars and creation of factsheets and handbooks will continue. New research efforts directed towards providing local farmers with efficient production systems will also remain. As an example of new technologies being promoted in collaboration with federal and local government agencies, is the use of high tunnels and improved marketing strategies. Information generated by research about best performing varieties, appropriate cultural practices that include integrated pest management, market feasibility and consumer preference studies, will be disseminated to growers and agronomists.

Fruits including mango, pineapple, citrus, papaya and avocados are important local crops. Recent research and extension efforts towards the local citrus industry consisted in producing citrus-tested plants for *Candidatus Liberibacter asiaticus* and developing educational materials about the nutritional management and control of the insect psyllid vector. As part of the initiative with the Citrus Clean Plant Network, testing citrus plants for systemic diseases will continue. Research on mango production will focus on evaluation of pollinators, correct identification and monitoring of fruit-fly species in commercial orchards, and disease management. These efforts will be conducted in collaboration with private industry. Extension personnel will continue to train growers and disseminate the results of their field experiences and of PRAEX research products.

The latest research and extension efforts for coffee production have been focused on the management of the “coffee berry borer”, emphasizing biological control and the search for new parasitoids. Additionally, social economic studies were conducted, engaging the coffee industry and small growers. New directions will move towards the validation of coffee rust resistant cultivars against the new race of *Hemileia vastatrix*. Outreach will highlight research findings and provide training for extension personnel and coffee producers.

PRAES and PRAEX have initiated the use of vegetative propagation methods and tissue culture to produce high quality yam and arracacha plants. Disease detection and identification methods by the Plant Disease Clinics will continue with early disease detection methods and molecular screening tools.

There is consensus on the need to restore local crop production in order to reinforce Puerto Rico’s food security. Strategies to increase crop production will focus on empowering small farmer’s knowledge through research and extension. Such efforts will provide them with high-quality seeds, new varieties, and the necessary technology to incorporate in their farms new management practices, which will be crucial for the sustainability of local food production. Dissemination of information about new disease and pest reports will be available through appropriate social media and PRAES online webpages.

In terms of animal production, challenges such as heat stress, inadequate adaptation of breeds for tropical production, farm and employee’s management, elevated costs of production (especially feed imports), poor forage management and utilization, imports of animal products, and more recently, geophysical and biological disasters, negatively impact livestock production. Goat and sheep, rabbits, pork and beef cattle farmers, and dairy farmers are re-organizing and creating cooperatives to develop more competitive agricultural enterprises. More than ever, these farmers will need our technical assistance to develop proposals to bring external resources, understand how to comply with applicable laws and regulations and develop strategies to encourage added value and marketing to their products. Impact at the farm level relies on education, research and training methods to encourage adoption of recommended management practices of either a traditional or innovative nature. More alliances with innovative and successful farmers and the creation of more demonstrative farms should be considered as strategies to increase adoption of recommended practices by PRAES and PRAEX. Farm visits should be intensified to better capture the success of our farmers (associated with our technical assistance) and use this information to strengthen our credibility and relevance to our clientele. Research and Extension efforts will focus on seeking improvement in the biological efficiency of livestock production, economic returns to the producers, and practices that promote extreme weather resilience. Additionally, increasing involvement of UPRM students with current local agricultural challenges is a new modality that some PRAES and PRAEX faculty members are employing as a means to improve students’ academic performance while helping our local agriculture by producing new technologies.

EXTREME WEATHER, NATURAL RESOURCES AND ENVIRONMENT, AND SUSTAINABLE ENERGY

As the world continues to experience the effects of climate change, no group will be impacted more than farmers. Between diseases, pests, wildfires, floods, droughts, and increasingly severe weather patterns, each growing season seems to come with more challenges than the last. Extreme weather undermines the ability of farmers to grow food in a productive and environmentally sustainable way. To be successful in addressing extreme changes in weather, we need to encourage farmers to increase the use of sustainable agriculture practices such as cover crops, no-till, rotational grazing, among others, that help in protecting our natural resources. These practices are recommended for soil conservation and also increase the soil's ability to serve as a sink to sequester carbon. The use of better soil management practices also allows for long-term agricultural production. To encourage agriculture that is both resilient and sustainable, radical new approaches for agricultural production are needed.

New agricultural approaches must build on a diversity of solutions that maintain and enhance the adaptive and transformative capacity needed to respond to disturbances and avoid critical thresholds. To identify these approaches will require that we encourage experimentation, innovation, and learning, even if they sometimes reduce short-term production efficiency. For example, after hurricane María, renewable energy became a critical issue. We modified our educational plan and included workshops, meetings and demonstrations to educate the public on energy use efficiency. We established collaborations and provided assistance to farmers, families and 4H members promoting renewable energy.

Extreme weather will continue to have a large impact on Puerto Rico. Prime agricultural land is a limited resource on the island and is constantly threatened by urbanization and soil erosion. Extreme weather events such as hurricanes, very intense rainstorms and flooding, which have now become more common, are main contributors to soil erosion with its negative consequences on watersheds. Though Puerto Rico's agriculture is very diverse, characterized mainly by small family production units, often with a variety of tropical crops and animals, the effects of land degradation without mitigation strategies will become insurmountable in the near future.

To achieve our goals, we will be maintaining and strengthening collaborations with USDA agencies such as the NRCS, Forest Service, as well as state agencies such as the Department of Natural Resources and Environment, the Environmental Quality Board, the State Department of Agriculture, and other non-government agencies. Since some of the agricultural critical issues may be similar to other ecological areas within the tropical region, collaboration with other land-grant universities will also be encouraged.

Research efforts will be directed towards identifying successful adaptations to extreme weather events based on risk exposure assessments and agricultural biodiversity practices. Issues related to soil quality and best management practices, mitigation of threats to water quality, microirrigation technologies for water conservation and improved crop productivity, as well as the identification and protection of natural enemies of harmful insect pests, continue to loom large in our research program. Lessons learned from Hurricane Maria's impact on forest resources and on the status of bee populations are being integrated into projects that research and facilitate the creation of a sustainable forestry industry in Puerto Rico, and the conservation of melliferous plants for ecosystem recovery and pollinators survival.

FOOD SAFETY SCIENCE AND TECHNOLOGY

The Center for Disease and Prevention (CDC) estimates that each year, roughly, 1 in 6 Americans (or 48 million people) becomes sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases. According to CDC (2017) 60% of the outbreaks occur in restaurants. To reduce the number of outbreaks, public health agencies require that food managers take and approve a food safety course. Such is the case of Puerto Rico, which adopted the Food Code since the year 2000.

The Food Code requires that food managers demonstrate food safety knowledge. Research highlights that food safety certification improves food safety knowledge. Among restaurants, the major difference between those with foodborne disease outbreaks and those with non-outbreaks is the presence of a certified kitchen manager. Accordingly, Puerto Rico Agricultural Extension Service (PRAES) priorities remain to offer the Food Safety Certification Course (FSCC) to people in charge of retail food establishments, and to continue offering formal education to professionals that enforce food compliance regulations.

In addition, homes are also at risk. The majority of the food that people consume is prepared at home, therefore there is

opportunity for unsafe food handling practices. Studies have found that behavioral changes in consumers are related to the knowledge they possess. The PRAES will continue to offer food safety short courses such as the Families Be Food Safe. This curriculum is adapted to the clientele's needs and lessons are added to meet them.

In 2011, the Food Safety Modernization Act was implemented. This law contains seven rules, which strengthen the food safety system, enabling the FDA to better protect public health. The new food safety system is based on prevention rather than reaction. Out of the rules created under FSMA, the Produce Safety Rule impacts most small farmers in Puerto Rico. The water rule, microbiological criteria for agricultural water and postharvest water, is the main reason why farmers in Puerto Rico perceive this rule as challenging, due to the cost associated with sampling. Planned research efforts will be directed towards identifying small farmers in need of water sampling to comply with the Produce Safety Rule, and in conducting water sampling on their farms. Analyses of results and continued training of farmers in good agricultural practices will hopefully help them assess their agricultural water quality and make any change needed to safeguard production.

Puerto Rico imports more than 80% of the food consumed. During the COVID-19 pandemic farmers are producing agricultural crops but the sales are down, because of the curfew imposed by the government to help stop virus propagation on the island. This situation underscores the importance of helping small producers add value and extend the shelf life of their fresh produce. In addition, the development of new products may increase food production in PR. Accordingly, the research and development of new products that add value to local farinaceous crops, such as plantains, sweet potato, and celeriac, and to others such as watermelon and papaya, will continue to be important in our research program.

COMMUNITY, ECONOMY, AND SUSTAINABLE DEVELOPMENT

Puerto Rico has been experiencing an economic recession for more than a decade. Even before the onslaught of the hurricanes that devastated the island in September 2017, Puerto Rico's economy exhibited high unemployment rates (11.7%) and low job market participation (40%). According to the Census Information Center at UPR-Cayey, poverty levels increased from 44.3% before the hurricanes to 52.3% after their impact. Moreover, outward migration, responsible for an estimated 10% contraction in population from 2010 to 2017 is expected to continue if economic recovery efforts are delayed, as is already the case.

The agricultural sector was particularly impacted by the hurricanes, losing about 80% of the value of its crops. With no jobs readily available, many rural laborers migrated to other sectors where rebuilding efforts started, or to the US, where FEMA and state governments implemented temporary relocation programs. The availability of the workforce needed to help with farm recovery became an additional challenge for the sector, stressing the importance of creating better paid, local employment opportunities, and of increasing labor efficiency.

Unfortunately, Puerto Rico has been recently hit by other extraordinary events that compromise the resiliency of its population: the earthquakes of early 2020, and now the COVID-19 pandemic. The social and economic vulnerabilities already present in the island are expected to increase in the near future by the cumulative impact of all these phenomena. More than ever, Puerto Rico needs to improve its food security and generate income-producing alternatives that can significantly increase the recovery prospects of its communities. Research and extension programs already underway targeting these issues will continue with renewed urgency.

From the research side, priorities include the identification and development of new, profitable niche markets for Puerto Rico's commodities through valued added alternatives and creation of differentiated products; and the study of consumer's attitudes and demand for these types of products. Projects evaluating technologies that can potentially improve labor productivity, particularly in coffee harvest, are also being planned and implemented. Finally, projects following methodological approaches that facilitate interdisciplinary collaborations and integrated perspectives in support of local food systems are also being explored and applied. The assessment of the potential adoption by farmers of innovative farm management practices will also continue. In summary, our research program will remain focused in the strengthening of agriculture and local food systems as a means to improve the island's economy, employment situation, and food security.

On the Extension side, the approach followed to target the critical issues identified is to continue joining efforts with other educational program areas to foster self-employment, community microenterprises, small businesses, and the development of third sector entrepreneurs in communities. More than ever, community outreach is essential to develop a

culture of resilience. In the aftermath of Hurricanes Irma and Maria communities were forced to take a proactive approach towards their physical and economic recovery. The government proved to be unable to meet people's needs during a crisis. The community self-management approach allows for the development of community resources to shorten the recovery response period, and better prepare people to handle an emergency. Now with the pandemic, small scale-farmers and producers, NGO's and community organizations are reinventing themselves by adopting CSA practices through social media networks, mostly using ICT (Information and Communication Technology) such as mobile phones. To support these efforts, the Agricultural Extension Service of Puerto Rico (PRAES) must diversify its teaching and learning process to adapt to clientele needs. The resilience process is not exclusive to the communities, PRAES has to change to adapt to the local and worldwide reality. It will be necessary to begin a continuous training process for PRAES staff to be prepared to guide communities to face their challenges. Following this process, PRAES remains focused on five areas in which capacity building is needed to enhance resiliency and sustainable development levels: community food systems, emergency plans, volunteer programs, alternative energy, radio communication, and entrepreneurship.

The Agriculture and Family and Consumer Sciences programs provide training on marketing and family finance helping participants to create business. Combined with the entrepreneurship training available under the Community Resources Development (CRD) educational program, it allows for the development of business plans that follow the requirements and recommendations of the Small Business Administration.

The second area of emphasis in CRD aims to broaden the educational offerings in disaster management and emergencies plans to cover for the organization, planning and development of practical activities before, during and after an atmospheric phenomenon, earth movement, or human origin emergency. In this way, we can be pioneers in community resiliency development that allows people to overcome these challenges in the future.

The third area of emphasis is the promotion and development of the volunteers' program. Volunteers are an essential component of community projects' success. Puerto Rico counts, since 2004, with Law 261 that establishes volunteers' duties and responsibilities. After the hurricanes, the volunteer culture has been growing; they have been an excellent resource during the recovery period. PRAES is in the process of creating protocols to integrate and to work with volunteers as a community resource.

The fourth area of emphasis is in radio communications and alternative energy or solar energy. The vulnerability of the island's electric infrastructure was evident after 100% of families experienced a total blackout during months after the hurricanes' crisis and again, briefly, after the January 2020 earthquakes. To be able to communicate across the island, PRAES implemented a radio communication network in five strategic sites across four regional offices and headquarters. During emergencies, these centers will serve as resilience centers helping communities and first responders to stabilize and start recovery efforts.

A fifth area of emphasis, an ongoing trend of great concern, is focused in the loss of farms, community food systems, and ecosystem value to other irreversible uses. In the last 30 years, Puerto Rico has experienced a loss of 43.54% of the land area in farms. Twenty percent (20%) of this loss occurred in just a 5-year period (between 2002-2007). Despite the fact that Puerto Rico has a "Land-Use Plan" approved in 2015, it only protects 600,000 cuerdas of farmland from an estimated total of close to a million cuerdas needed to guarantee food security. For this reason, it is necessary to continue promoting the identification and encourage community action around the conservation and development of the land area in farming, and of ecosystem value. This is of utmost importance given the interest in recent years in the development of economic initiatives through vegetable gardens and small-scale farm production.

FAMILY WELL-BEING

The Family and Well-Being component will work in health promotion and disease prevention, and family resource management to improve the quality of life of our vulnerable populations. The health promotion and disease prevention program focuses on areas of chronic and infectious diseases and prevention interventions. The family resource management will focus on helping and empowering the individual, family, and community to face up to their current and future financial needs. Since the passage of Hurricane Maria in 2017, Puerto Rico continues to recover. The Family and Well-Being program continues attending health disparities issues and support, though education, families on social, health and hygiene. In addition, we continue forwarding our educational programs about spending and savings plans and making strategic decisions that favor family well-being.

Since December 2019, Puerto Rico has been affected by multiple earthquakes in the southwest area of Puerto Rico. Between January 6 and 7, 2020 two earthquakes occurred 8.4 miles offshore southwest of our Island with a magnitude of 5.8 and 6.4, respectively. The January 7 earthquake resulted in multiple infrastructure damages to homes, schools, day-care centers and agricultural facilities. Power outages left thousands of people across the island without electricity and water services. Also, several hospitals were operated with generators. The affected municipalities, including Ponce, Peñuelas, Guayanilla, Yauco and Guanica are mostly rural and agricultural and populated by socioeconomic disadvantaged communities. A state of emergency was declared by the President of the United States on January 8th. Since then local health and emergency management authorities are working in the recovery process for the affected communities.

A more recent challenge, the 2020 COVID-19 pandemic, is advancing through the Caribbean Region as well as in Puerto Rico. Our local government and health authorities have been adopting public health measures to limit the spread of the disease. However, the COVID-19 situation causes a pandemic search for information with broad dissemination of false misleading health information. Through effective health education and communication interventions the Family and Well-Being program is and will continue promoting health behavior changes. It is important to provide to families and individuals of all ages including socio-economically deprived, low literacy, underserved, varying disabilities diseases and impairments, information in clear, specific, unambiguous and consistent lay language in order to educate about preventive measures to contain the dissemination of COVID-19, as well as emergency disasters preparedness, hurricane and earthquake awareness and communicable and noncommunicable diseases.

Considering all these events, our planned program for year 2020-21 will work in the following:

- Design educational materials to encourage healthy habits in order to prevent the spreading of infectious diseases; money management; food safety, food security and nutrition; and family development.
- Engage families through hands-on educational activities that promote a culture of health and wellness for all family members and communities.
- Encourage digital learning experience as well other communication media and tools through workshops and web-based curricula to address topics such as: oral health; hand hygiene, physical/social distancing, and chronic and contagious disease treatment adherence and prevention; housing cleaning and disinfection; emergency preparedness to food security, financial security and property protection; food safety, nutrition and physical activity; family resource management and financial decision-making; parenting education; adult and family relationships; adult development and aging.
- Disseminate science-based information regarding COVID-19 and other diseases that local epidemiologic surveillance reports.

POSITIVE YOUTH DEVELOPMENT

According to the national initiative "Healthy People 2020", teens who can handle the changes and risk factors associated with the adolescence period become successful, happy and healthy adults. Adolescence is a critical time for the development of lifestyles, practices, attitudes, and beliefs related to health and well-being. The office of "Adolescent Health" pointed out that adolescents should experience five essential components for a healthy growth such as: positive connections with support people, a safe place to live, the ability to learn and play, access to a high quality environmental resources, access to adolescent health services and education and public policy development facilitators. Access to service centers that promote family and youth well-being are also fundamental during this process. Youths being exposed to a learning environment where they can be learners as well as leaders.

Recent Natural and Biological disasters have dramatically impacted youth's mental health and academic achievements. These increased the situation of child poverty on the island and accelerated the migration of families with children. The Youth Well-Being Index (YWBI) from the Youth Development Institute prepared a radiography of the state and conditions of boys/girls between 0 to 21 years old living in Puerto Rico. The YWBI obtained by our children was "D" due to high child poverty and low academic achievements, among other factors considered. This situation affects the opportunities for children and youth and their well-being. As evidenced by the statistics before hurricane María, 58% of our children and youth were living in poverty. Recent emergencies in the island (i.e., earthquakes and pandemic) demonstrated that

children and youth are more vulnerable than ever. Currently, they lack educational opportunities due to closing of the educational system, access to food at public schools, greater economical challenges, loss of homes, and due to the public lockdown an increased rate of child violence. These are factors hindering the child and youth development, and healing process. Studies have shown that living in poverty may result in chronic stress for children, which has an adverse effect on learning, memory and health problems, among others. Several studies have shown how natural disasters cause post-traumatic stress disorders that may persist for many years after the event.

Given this situation, the 4-H Educational Program is focused on creating safe learning spaces, establishing positive contacts and provide opportunities and experiences for children and youth to develop skills and abilities to become healthy individuals that positively contribute to our society.

As recommended in our 4-H Merit Review processes, we propose to continue working with youth leaders through internships in order to promote: emotional support systems for youth volunteer leaders, and efficient coping mechanisms before, during and after natural disasters and emergencies. Our POW will promote: educational activities at communities, with special attention to those affected by recent natural disasters, support youth leaders and expand 4-H enrichment activities in order to help kids and youth move forward after natural disasters and emergencies. Through these activities youth and adults will work and learn together about health advocacy, emergency preparedness, diseases prevention among other topics to strengthen their knowledge and skills to help others and empower themselves.

2. FTE Estimates

Year	1862 Extension	1862 Research
2021	140.0	52.5
2022	135.0	53.0
2023	132.5	53.0
2024	130.0	53.0
2025	130.0	53.0

II. Merit / Peer Review Process

The Extension Merit Review process continues to be conducted through four committees representing each of the four major program areas: Agriculture, Marketing and Natural Resources; Family and Consumer Sciences; 4-H and Youth Development; and Community Resource Development. Each committee is composed of at least five members: Internal University members (the program leader, two specialists--one from the Planning and Evaluation Office and one from the major subject area), a researcher from the Agricultural Experiment Station and other faculty members, and external non-University members (representatives of the major government agencies or organizations that work with similar audiences). External Members in the different committees include representatives from government agencies at the regional or state level, such as: Department of the Family, Department of Education, Department of Agriculture, the Mayor's Office, the Governor's Office for Youth Issues, Rural Development Corporation, the Farmers' Association, Farm Service Agency, Consumer Department, Head Start, Police Department, as well as representatives from non-governmental organizations, the religious sector and the private sector, among others. Each committee meets at least twice during the fiscal year to evaluate the proposed plan of work. External committee members evaluate the quality and relevance of the activities and programs to the State goals and offer recommendations in order to continue emphasizing critical areas in our programs. A written report is prepared at the end of each fiscal year by the program leader, in accordance with the committee members. The report is presented to the committee and describes how the committee's recommendations will be addressed and incorporated in the Plan of Work.

No significant changes are expected for the PRAEXS merit review process. Part of the Hatch funds will be allocated for competitive project grants. The competitive funded proposals will be selected on the basis of the year's revised priorities published in our annual call for proposals. The annual call for proposals will be prepared and distributed by the recently

integrated Research and Sponsored Programs Office. This new office combines the research activities for both the Agricultural Experiment Station and the Cooperative Extension Service. We expect this new arrangement will promote a closer collaboration between both units concentrating our combined efforts towards one common good.

Another part of the budget will be allocated for specific signature projects of the PRAEXS. These signature projects encourage emerging or incipient agricultural research areas that need to be developed in Puerto Rico. At the same time, the Agricultural Experiment Station will be promoting the management of tropical agroecosystems under changing climatic conditions. All the proposals (competitive and signature projects) will be submitted to the Assistant Dean for Research with the endorsement of Department Heads, and their scientific merit will be evaluated by internal and external reviewers.

III. Stakeholder Input

1. Actions to Seek

In order to seek input from the stakeholders the PRAES will make use of traditional media to announce public meetings and listening sessions. In addition, targeted invitations to stakeholder groups or individuals and surveys of stakeholder groups and individuals. Extension's stakeholder input process conveys mainly traditional participants or regular program's clientele who are members of the Local Advisory Committees. This clientele has vast experience on the four major Extension program areas and include farmers, homemakers, youth as well as community leaders. State agencies' representatives with similar clientele, who are also members of the local advisory committees are invited to participate in the stakeholder input process.

Two types of meetings are held to identify critical issues that PRAEXS programs should address. First, we will continue with commodity meetings where stakeholders can participate by stating their opinion on research priorities. We have currently identified seven commodity groups of importance to Puerto Rico's economy: coffee; farinaceous crops; fruits; vegetables and basic grains; milk and forage; environment, natural resources and renewable energy; and meat production. Each commodity has a yearly meeting. Organizers identify and invite members of producers' associations, individual farmers, faculty and students, government officials and community organizations with an interest in the commodity and related research programs. These meetings are also announced on the PRAEXS web page, podcasts, and radio programs.

Second, workshops, seminars, field days and symposiums are periodically held; here research results are shared and the research and extension needs or public policy determinations are discussed. Participation in these thematic activities is encouraged through internal university communications, emails sent to already identified stakeholders, press releases, podcasts, and the use of social media such as Facebook and Twitter.

2. Methods to Identify

PRAES methods to identify the stakeholders entails the use Advisory Committees, Internal Focus Groups or Needs Assessments. In some instances, the use of a survey could be employed. Extension's stakeholders are mostly the local (municipal) advisory committee members.

PRAEXS uses commodity meetings to identify groups and individuals from which to collect information. In addition, the use of workshops and symposiums where farmers and the scientific community meet is another method of identifying stakeholders. Since many meetings are also announced on the PRAEXS web page, interested public not targeted by these invitations also attend the meetings.

3. Methods to Collect

The methods to collect information most often used by PRAES are meetings with traditional Stakeholder groups or individuals, survey of traditional Stakeholder groups or individuals, survey specifically with non-traditional groups or individuals, focus groups and or electronic communications.

Input from Extension's stakeholders is collected at the local advisory committee's meetings. Stakeholders are asked about the issues affecting their livelihood within the areas included in our educational program areas that cover: agriculture, families, youth and communities. They are also asked to prioritize these needs or issues. Focus groups are commonly conducted to ensure the priorities identified. A written report is prepared by the local Extension personnel in collaboration with the committee members and sent to the PRAES Planning and Evaluation Office at the State level, which collects and analyzes the written information and data collected.

The information collected in a report at the local (municipal) level for the Stakeholder Input is designed for this purpose. It shows the date of the meeting or activity, attendance, summary of needs and priorities selected, procedure to determine

and set priorities, limiting factors and suggested research needs. Another tool at the local level is a form to collect demographic data which is updated every five (5) years. This document provides for a broad picture of the local situation regarding the following items: population (changes, ages, gender); economy (agriculture, industries, tourism), social factors (employment, education, families, social programs), and environmental factors (water supply, contamination sources, recycling programs, natural reserves).

PRAEXS collects stakeholder input through personal communications and evaluation forms distributed at the end of meetings, workshops, field days, seminars and symposiums. Stakeholders are asked about the most critical issues affecting their commodities and their local areas, as well as our research priorities. This information is summarized in a report prepared by the commodity and program leaders. Increasingly, stakeholders contact researchers through social media (Facebook, Twitter) and make comments to podcasts (uprm.edu/desdelaeaa). Stakeholders initially identified by these means are included in subsequent commodity or research activity invitations and their concerns are also included in the reports presented to the CAS administration.

4. How Considered

All the information collected from the stakeholders is considered in the budget distribution, identification of emerging issues, redirection of extension programs, staff hiring process, action plans and to set priorities. In order to set priorities for our educational programs, input collected from the Extension's stakeholders will be received at the state level and discussed with program leaders, the Planning and Evaluation Office, and the Associate Dean. Data collected from the stakeholders at local level, will also be shared with the specialists, according to the area of need. Needs related to the area of agriculture will be collected in a report to be sent to PRAES specialists that participated in the commodity joint meetings with PRAEXS. When there are issues that require attention, the programs are redirected to address these issues. Also, new emerging issues are identified through these processes and analyzed according to the staff and resources available to address. At the local level, input offered by the stakeholders is used to set priorities for their local plan of work. Statistical data from the State Health Department, Agriculture Department, Social Services, School of Family Science and Consumer Education, are also considered to respond to public policy issues. When there are issues which need to be emphasized, programs are redirected to address these issues. This process may also be used to make decisions about recruitment of new faculty members.

Research activities subsidized by the Hatch funds are partially aligned with the priorities disclosed by the stakeholders. The list of priorities assembled through the process described previously guides the year's call for proposals for new Hatch and Special projects and is also considered by researchers when applying for externally funded grants. In special cases, specific research projects could be created in order to meet stakeholders' urgent requests. In cases where the needs expressed by stakeholders cannot be met by the PRAEXS, an internal evaluation will be performed to consider the possibility of recruiting new faculty members with the desired expertise. When there are issues which need to be emphasized, programs are revised to address these issues.

IV. Critical Issues

1 Food security, plant & animal systems

Description:

Puerto Rico imports over 80% of the food consumed, which travel thousands of miles from its place of origin. During the last 5 years Puerto Rico has faced many challenges including hurricanes, earthquakes and now the COVID-19 pandemic, among other risks that underscore the vulnerability of our food chain. For this reason, PRAES and PRAEXS will collaborate on increasing public awareness of the vulnerability of our current food system. Improving the system's biosecurity will demand that well planned programs are adopted by farms that supply food products. The focus of this effort will be to increase local animal and crop production and consumption. Research and Extension approaches will target the adequate use of inputs and efficient use of energy and water for a sustainable local animal and crop production system that promotes food security. Crop production systems research will focus on the availability of quality seeds; characterization, evaluation, and development of crop germplasm; identification and management of key pests and diseases; and on the adoption of sustainable practices. Animal science research will remain focused on strategies to improve production in warmer climates, particularly through studies of a slick hair phenotype/gene that appears to be an adaptation of cattle to heat stress; production strategies to add value to cattle raised grazing tropical grasses; and studies to improve the production, management, and well-being of small ruminants and add value to their sub products such as goat milk.

Term: Long

Science Emphasis Areas

Human Nutrition
Sustainable Agricultural Production Systems

2 Extreme weather, environment & sustainable energy

Description:

IPCC findings showed that the tropics and islands are most vulnerable to extreme weather events, increasing the risks for agricultural production. With extreme weather events becoming more common, we face the challenge of generating a food system that can absorb and recover from such stressors. Vital resources such as soil and water are especially susceptible; invasive species threats and urban sprawl complicate the island's outlook.

Recent weather events forced PRAES to assist with and encourage the adoption of renewable energy options in agriculture. Our educational plan conveys workshops, meetings, and demonstrations. Research efforts continue to focus on issues related to soil quality and best management practices, mitigation of threats to water quality, microirrigation technologies, and on the identification and protection of natural enemies of harmful insect pests. Lessons learned from Hurricane Maria's impact on agriculture and forest resources are being integrated into projects that research and facilitate the creation of a sustainable forestry industry in Puerto Rico, sustainable power generation after natural disasters and agroecological practices adapted to extreme weather conditions.

Term: Long

Science Emphasis Areas

Environmental Systems
Sustainable Agricultural Production Systems

3 Food safety, science and technology

Description:

To reduce food borne disease outbreaks, public health agencies require that food managers take and approve a food safety course. The Food Code, adopted in 2000, requires food managers to demonstrate food safety knowledge. PRAES continues offering courses to people in charge of retail food establishments, and to professionals on compliance regulations. Homes are also at risk. The PRAES will continue to offer food safety short courses to family participants. To implement the new Food Safety and Modernization Act, the FDA has developed a series of regulations that local food industries must comply with in order to achieve a safe food supply. Compliance with these rules is the only way that local farmers and food industries can become fully competitive in current markets. To help farmers and local food companies comply with the applicable rules, PRAEXS will continue providing food safety training to food industries and local farmers. Research efforts that address local producer needs related to adding value, extending the shelf life of fresh produce, and maintaining products' distinctive characteristics in differentiated markets, will also continue to be important in our research program.

Term: Intermediate

Science Emphasis Areas

Food Safety
Human Nutrition

4 Community, economy & sustainable development

Description:

The regeneration of agriculture and employment are long term issues exacerbated by the devastation that Hurricanes Irma and María inflicted on Puerto Rico in 2017. A 6.4 earthquake in 2020 and the COVID-19

pandemic further challenge ongoing recovery efforts. New research and extension activities will continue to focus on the promotion of potentially profitable markets for local products, value-added alternative to increase the price of agricultural commodities, best practices and models for addressing complex food-system issues, sustainable employment creation through entrepreneurship and self-management skills training, and community participation organizational skills training to better address community needs. Research and extension initiatives targeting resiliency, land tenancy, financial, labor market participation, and public policy issues, will also be explored.

Term: Intermediate

Science Emphasis Areas

Bioeconomy, Bioenergy, and Bioproducts
Education and Multicultural Alliances

5 Family well-being

Description:

The current COVID-19 pandemic has disproportionately affected our communities due to a variety of factors including: high number of older adults with comorbidities, poverty, deteriorated essential service infrastructure (power, water, health, education), inadequate housing, and recent natural disasters. After the catastrophic hurricanes of September 2017, the earthquakes of early 2020 and now the COVID-19 pandemic, the socioeconomic and health disparities are increasing among vulnerable populations in many parts of the island, in particular the elderly. Older adults are more likely to have diabetes, hypertension, and obesity and consequently are at high-risk for COVID-19 outcomes. Also, people with obesity are at risk of COVID-19 severe disease and other health conditions. Puerto Ricans have higher rates of obesity that affects not only the older adults but young people including children. Another challenge is the all-year round presence of arboviral diseases that complicates the ongoing COVID-19 situation. On the other hand, COVID-19 impacts not only the physical health but also the mental health of our populations. It is important to reinforce our efforts into community educational interventions to promote the overall physical and mental wellbeing. Our educational prevention efforts will be focused to encourage healthy habits such as COVID-19 protection, physical activity initiatives, chronic and infectious disease management, and healthy family relations not only to senior adults and their caregivers but also attending younger populations.

Term: Intermediate

Science Emphasis Areas

Family & Consumer Sciences
Food Safety
Human Nutrition

6 Positive youth development

Description:

Youth in the Caribbean archipelago have faced emergencies caused by hurricanes, earthquakes and now a pandemic. The lack of educational opportunities and inaccessibility to food, due to closing of schools, and the increase in domestic violence, associated with the lockdown, increase youth vulnerability. These challenges are a potential physical and emotional threat to children and adolescents.

Youth and 4-H Program will direct their efforts to create safe spaces for learning, establish positive contacts and offer opportunities and experiences for children and young people to develop skills and abilities that allow them to become healthy and committed leaders and adults. Cultivating youth and adult partnerships will be our milestone. Positive youth development initiatives and theories consistently agree that youth who receive mentoring and adult support can achieve healthy and affirmative relationships. When adults express interest in the well-being and care of the young they provide them with opportunities for growth, it inspires, and provides a genuine environment to raise the voice of the young people allowing new opportunities of working relations and joint projects.

Term: Long

Science Emphasis Areas
Youth Development