

# Puerto Rico (University of Puerto Rico Mayaguez Campus) Annual Report - FY2022

## Report Status: Approved as of 06/30/2023

### Contributing Organizations

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University of Puerto Rico Mayaguez Campus

### Executive Summary

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#### Overview

This annual report includes what the University of Puerto Rico's Agricultural Experiment Station (**PRAEXS**) and Agricultural Extension Service (**PRAES**) consider to be our most salient research and educational achievements during FY2021-2022. As the island continued to battle the pandemic and its dire social and economic impacts, Hurricane Fiona struck Puerto Rico in September 2022 again causing widespread damage and disrupting power and water service for nearly two weeks after the storm. Many research labs and field experiments were affected, and research and extension faculty had to readjust their projects and programs plans to meet the new reality. Moreover, the University's fiscal situation remains challenging, triggering dozens of employees to resign and limiting the hiring of new faculty and non-faculty appointments needed to strengthen our programs and accelerate recovery efforts.

Despite these limitations and setbacks, progress has been achieved in priority research and extension programs for Puerto Rico's rural economy. As a recent ERS publication depicts, "coffee farming has remained a dominant land use and an important source of economic activity for thousands of farmers in the central highlands of the island, providing employment to thousands of hired workers" (USDA-ERS, AP-114, April 2023). A focal point of our combined research and extension strategy is to strengthen a specialty coffee producing sector. Accordingly, highlighted research results this year include economic studies of the differentiated coffee market, attention to the phenotypical characterization of coffee rust resistant varieties, and experiments with innovative processes to aid with coffee processing and produce new value-added products. Given the recurring impacts of drought in PR, recent microirrigation research has integrated coffee into the crops being studied. Extension results also underscore continuing efforts to provide tools to enhance coffee quality and marketing opportunities to promote competitiveness and economic benefits to our farmers.

In terms of animal production, combined efforts between PRAES and PRAEX have been concentrated at improving the bovine productive efficiency by evaluating neonate feeding strategies that result in optimal development. Additional efforts of PRAEX and PRAES included the evaluation of improved tropical forage species, destined to feed cattle, that result in the best economic benefit to our farmers. The factors considered in this study included the best agronomic management practices to produce improved forages considering the different agroclimatic regions of Puerto Rico.

This report includes accomplishments and results from the following six Critical Issues defined in our 2022-2026 approved POW:

1. Food Security, Plants and 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 and Well-Being
6. Positive Youth Development

"**Food Security, Plants and Animal Systems**" continues to be the critical issue that concentrates most of our research and extension projects and programs. Results from ten research projects, three of which are in collaboration with extension, drive the progress reached in this issue during the year. Food Security is addressed in the PRAEXS through projects that target stakeholder's concerns regarding lack of seeds to expand plantings, availability of disease resistant cultivars and of prospective profitable new crops, plant varieties better adapted to organic systems, and on improving economic returns to livestock producers through both breeding and best forage and overall management strategies.

PRAES efforts towards Plant Systems focused on adding value to the coffee produced in Puerto Rico. Educational activities and follow up visits were centered in providing producers the adequate management practices at the pre- and post-harvest level to improve the quality of their coffee. Additional training provided recommended marketing strategies to improve their competitiveness in the market and generate an economic benefit. In animal systems, combined research and extension efforts to characterize the slick haired phenotype in the *Bos taurus* dairy breeds have also continued.

The "**Extreme Weather, Natural Resources and Environment, and Sustainable Energy**" critical Issue is also a particularly important research program for PRAEXS. More than 20% of our total projects contribute to this issue's progress and while the majority are sponsored by non-capacity funds, Hatch funding remains critical for leveraging additional external resources. Four research projects were highlighted that showed progress at addressing problems worsened by the impact of hurricanes, the occurrence of algae blooms in water reservoirs, and underscoring the importance of assessing soil conditions and sustainable technologies for crop intensification such as microirrigation. One PRAES program was highlighted that continued focusing on

mitigating the impact of climate change on agricultural production. Among the most salient activities included train the trainer workshops to extension agents around the island and collaboration with NRCS to expand the dissemination of soil nutrient management information to farmers, producers, and the general public.

Research projects in the **"Food Safety, Science and Technology"** critical issue continue to monitor food safety issues that that may present a challenge to small farmers operations or a human health hazard, while also assisting in the search for alternatives to add value to farm products. This year's highlighted results show progress achieved in value-added alternatives for coffee, plantains, apio and goat milk. The Food Safety program of Extension continues providing courses to our audience on recommended food preservation practices, mainly to housewife, and the Food Safety Course to people in charge of food establishments.

Although our **"Community, Economy and Sustainable Development"** research program had several new projects starting this year, only one had significant results to highlight related to specialty and differentiated products as strategies to improve the economic situation of coffee and milk operations. Pertaining to PRAES activities, progress was achieved and highlighted under the community self-management, economic development, and volunteers' resilient projects during critical times program. During this period, the program activities focused on improving the capacity of our audience in producing their own food and generating income-producing alternatives that can significantly increase the recovery prospects of its communities.

Within the **"Family Well-Being"** critical issue, PRAES highlighted important progress through the existing Healthy and Sustainable Families Program. For this period, PRAES activities towards the goals of the program centered efforts in establishing alliances with several health-related organizations to expand the impact of our work. Efforts concentrated in educating women of 21 years of age or older about health, prevention and early detection of breast and cervical cancer.

Through the **"Positive Youth Development"** critical issue, a collection of interdisciplinary 4-H initiatives focused on creating inclusive spaces for child and youth. A new program was included for FY2022 that addressed efforts to help overcome the lack of educational opportunities and access to health services and food, which were exacerbated by the closing of schools. Through the Teens leading the change for community wellness program, PRAES provided access to fresh food and promote wellness to youth that are prone to homelessness.

#### **Critical Issue: Community, economy & sustainable development**

As depicted in our POW research efforts continue to focus, among other priority areas, on marketing strategies that could improve the livelihood of farmers and on providing the data needed to better tailor agricultural policies towards this goal. The potential of specialty and differentiated products, as strategies to improve the economic situation of coffee and milk producing farms, has been explored during the last decade and important conclusions on consumers preferences are now available to inform these industries marketing strategies. In the case of milk, results indicate that education, age, and gender of consumers affect their concern for animal welfare in their buying decisions. Results suggest that a marketing strategy for milk produced ensuring animal welfare can be directed towards women, the youngest and the most educated, since they were the most interested in this product. In the case of coffee, studies have found that consumers are willing to pay a premium for differentiated coffees in Puerto Rico, and that they prefer texts and logos over quick response codes to access the product's characteristics on the coffee bag. Highlighted project results include publications summarizing these conclusions.

PRAES activities pertaining to community, economy & sustainable development critical issue focus efforts in educating communities so that they can meet their needs and take actions to improve their quality of life through community empowerment and self-management. Some of the advancements pertaining this critical issue for FY2022 included 1) a total of 252 community visits that resulted with 451 interviews made to community members to identify basic community needs, 2) 32 courses offered on principles of organization, self-management and community empowerment benefiting 128 people and, 3) the collaboration of 56 governmental or non-governmental organizations with PRAES in the development and organization of communities. In turn, 39 communities were organized and 22 established a community project in collaboration with other Extension educational programs (4H, Agriculture or Family and Consumer Sciences) to solve one or more of pre-identified needs.

PRAES continue investing in our leaders to increase our impact and achievements. A total of 393 volunteers were trained in leadership and PRAES programs giving in return 433 hours of volunteer work as community leaders.

New progress was achieved under the Community self-management, economic development, and volunteers' resilient projects during critical times Program (**CSM**). Activities continue aiming to promote income-producing alternatives to increase the recovery prospects of our communities and improve their food security. Two awards were obtained that boosted the impact of this program, incorporating more than \$75,000 to build the necessary infrastructure. These fundings were used to educate community organizations about agroecological systems as a resilient management strategy and community enterprise, and to organize educational centers to train communities about aquaculture systems and marketing. As part of the CSM program result include the participation of 78 leaders in the design and development of their communities generating a total of 245 volunteer hours, 23 communities made progress in meeting their quality of life, 10 action plans were developed or updated by community members to address a problem and 2 communities were organized for the preservation and conservation of coastal resources and other natural resources.

#### **Critical Issue: Extreme weather, environment, natural resources, and sustainable energy**

One of the perils of production agriculture is the potential for surface and groundwater contamination due to excess fertilizer and/or soil amendment runoff. Even with good soil and crop management practices nutrient enrichment to surface and ground water could occur. One of the most pressing freshwater quality threats for future generations is the emergence of hazardous algae bloom. Algae blooms can have severe consequences on human health and on the environment. Nutrient enriched reservoirs as a result of runoff and erosion can be responsible for an increase in vegetation on the water surface. Project PRH-479, initiated in the aftermath of hurricane María, evaluated the use of drone-based sensors to monitor the incidence of

phytoplankton productivity in two reservoirs of Puerto Rico. Field bioassays were also used to evaluate the influence of nutrients and dissolved inorganic carbon on phytoplankton productivity. Results at Cerrillos reservoir showed that phytoplankton responded similarly to nitrogen and Phosphorus in increasing its productivity, however, no difference was observed to nitrogen source. Biomass productivity followed a logarithmic response with saturation values reached at elevated nutrient concentrations. In addition, increases in chlorophyll *a* has increased the trophic levels from oligo-mesotrophic condition of the Cerrillos reservoir to eutrophic levels. These results indicate that preventive measures need to be reinforced to prevent additional nutrient enrichment.

The area extent of saline soils in Puerto Rico is less than 2%, however, most of the soils in the area are quite productive when managed properly. One of the most important agricultural areas is the Lajas Valley Agricultural Reserve, which encompasses an area of over 40,000 acres primarily Vertisols, with irrigation-drainage infrastructure. Project PRH-483 was developed to update the distribution and extent of soil salinity in this area since that last time it was evaluated was in the 1950s. The results indicate that the area surveyed was 67% normal, 27% saline, 0% sodic and 4.3% saline-sodic. A comparison of these results to those from 1958 showed that 42% of the soils were normal and did not change, 7% of the soils were changed to normal, 3% of the soils changed from sodic to normal, 10% of the soils that were normal became saline, and 16% of the saline-sodic soils changed to normal. An overall increase of 18% of the soil area previously affected by excess salts changed to normal. These results show the efficiency and importance of soil and irrigation water management in saline soils.

Puerto Rico has been part of the multistate W-4128 (PRH-402) project for irrigation for many years. Throughout the years many forms and techniques of irrigation have been evaluated on different crops. Recently, climate change has had a significant effect on precipitation patterns in PR, specifically, an increase in drought periods. One of the most important crops in PR agriculture is coffee. These changes in precipitation patterns have focused the research in irrigation to the mountainous region where most of the coffee production is concentrated. Microirrigation levels were evaluated on coffee (Var. 'Catuai') yield to gather data and make recommendations regarding the use of drip irrigation for coffee plantations for the humid region of PR. While results showed no significant differences among drip irrigation treatments for the first year, data is been collected for a second year.

Finally, forestry research and outreach continue to progress hand in hand with Para La Naturaleza, an NGO dedicated to the conservation and reforestation of protected ecosystems. The results of project H-489 on how to use biochar will directly help on possible new formulations of growing media that include less amount of Promix. In addition, the data generated on the test of biochar in the field will help them improve their reforestation strategies.

Under this critical issue, PRAES aims efforts to improve resilience and response to extreme climate changes while maintaining productivity and protecting vital water and soil resources. The most salient educational activities of FY2022 included: 1) 24 people trained in collecting, storing, and re-using rainwater for agricultural purposes, 2) 31 people trained in fire prevention in forests and pastures, 3) 19 people trained in natural disasters and emergency management to reduce losses and maintain the operation of their farms. Of the people that were instructed in these topics, 15 reported adopting at least one of the recommended practices offered by PRAES personnel.

Achievements pertaining to the natural resource protection amid extreme weather and natural disasters program were highlighted under the new results (Mitigating the impact of climate change on agricultural production by improving agricultural practices, supporting soil and water conservation, and encouraging composting). A series of train the trainer workshops (n=6) were offered to extension agents covering soil sampling, soil analysis interpretation, and nutrient recommendations were provided. In turn, the county agents provided 15 trainings to 75 farmers on soil management and fertility. Soils from 30 farms were sampled and analyzed and results discussed with farmers providing the appropriate recommendations. New collaborations between PRAES and NRCS boosted the dissemination of information on soil nutrient management information to farmers, producers, and the general public. Some of the most important achievements of this program include the adoption of practices and recommendations that have improved the conditions on more than 45 farms, 11 farmers incorporated the use of soil amendments based on soil fertility results, 8 farmers changed their fertilizer formulations to more closely coincide with the needs of the crops grown and 52 individuals adopted recommended conservation practices to effectively manage the soils on their farms.

Other achievements of this program include the emergence of a new eggplant farmer in Isabela, PR. This farm was originally producing forages destined to feed cattle; however, it was not generating appropriate benefits to the farmer. After several visits, training, and recommendations from PRAES the farmer was able to reduce his fertilizer application by 75% while maintaining vegetable production. Through follow-up visits the farmer also learned about the importance of plant nutrition, how to read soil test results, how to recognize beneficial insects and practices to control plant pests. The farmer is currently in the process of starting a second farm.

#### **Critical Issue: Family well-being**

The Healthy and Sustainable Families program aims to promote family well-being, health and disease prevention, healthy eating, and the management of family resources to improve the quality of life of vulnerable populations. During FY2022, this program centered its efforts on educating our audiences about women's health and early detection of breast and cervical cancer; highlighted under the Health, Prevention and Early Detection Breast and Cervical Cancer Results. To expands Extension non-formal education to populations that lack access to information and educational services for prevention and early detection of cancer, PRAES Family Consumer Sciences established a collaborative agreement with the Puerto Rico Breast and Cervical Cancer Prevention and Early Detection Program (PRBCC). Educational activities on breast, cervical, colorectal, and other types of cancers were offered to 1,315 people in Puerto Rico. Topics presented to our audience included 1) identification and referring of women of 50 years of age or older who have not had a mammogram in the past two years to the Comprehensive Cancer Center and, 2) identification and referring of women of 21 years of age or older who have not had a Pap smear in the past three years; have no health plan; and that they are residents of the municipalities of the southwest region. Of the 1,315



people who received non-formal education, 488 women reported to recognize the importance of prevention and early detection of breast and cervical cancer and 15 women, without a health plan, were referred to the PRBCC. Particular attention was offered the southwestern region of Puerto Rico, which has the highest number of uninsured women, canalizing an early detection test to all 195 participating women.

**Critical Issue: Food safety, science and technology**

Research in this area continue to concentrate in strategies to add value to our crops and livestock commodities. Final results available from a project on the elaboration of flours, extruded products and chips from *apio* (Arracacia xanthorrhiza B.) and plantains show that Arracacia and plantain flour have attractive properties and can be used as an alternative for the food industry. Arracacia starch isolated from the rootstock had the lowest eGI (48.62), when compared with that stored in the root and stem, indicating starch rootstock is a low eGI food and a good dietary carbohydrate alternative for diabetic people. Work performed also demonstrated that *apio* can be extruded and used as a high-quality snack. The general acceptance of the apio snack was from 6 to 9 on a 9-point scale which corresponded to 70% of the panelists. Also, results from a survey of consumers preferences related to fresh or processed apio and plantains products provided some insights on which of these processed products have the most market potential in Puerto Rico.

In the case of goat's milk, an emerging niche market in the island, work on the development of *cajeta* and yogurt is on its final stages. The process confirmed that products made with goat's milk tend to have softer texture, and formulations used for cow's milk may not work for products with goat's milk. With the information gathered researchers are planning to offer short courses to all the dairy goat farmers that may be interested. Lastly, two projects are now addressing the coffee industry's efforts of regeneration based on specialty coffees and value-added products. In the highlighted "Controlled Fermentation Studies in the Manufacture of Specialty Coffees", experiments were done to evaluate the capacity of mucilage removal by selected commercial yeast strains. Results obtained so far showed that the yeasts used, by themselves, are not able to remove the mucilage, evidencing the need of other microorganisms to perform this function. Although the project is still in its experimental stages, we expect that the project activities will generate methodologies and procedures that will help to improve the quality and marketability of specialty coffees cultivated in Puerto Rico.

The PRAES Food Safety program trained all the Puerto Rico correctional administration personnel about proper management of food storage and expiration dates. Thanks to this training the correctional administration was able to update their guide of food handling standards and procedures for all the jails of Puerto Rico. All the Family Science and Consumer Educators were trained about recommended practices in dry storage and in turn, a total of 10 online courses were offered to the public in general.

**Critical Issue: Food security, plant & animal systems**

Research efforts to increase crop production for local consumption continue to focus on the supply of quality seeds and planting materials and on the management of key pests and diseases. The most important commodities in Puerto Rico for local consumption are bananas and plantains. The demand for tissue culture seedlings is growing and research into resistance to major diseases has resulted in the selection of banana FHIA02 (Monalisa). This variety is also a good alternative for organic production due to its desirable agronomic characteristics. For root crops such as sweet potato, yam, taro, tanager, white carrot (*apio*) and cassava, which depend on vegetative seeds, activities focused on the production of disease-free vegetative material. Protocols for yam (*Dioscorea rotundata*) have been tested and the results have been validated under field conditions. The initial phase to produce disease-free seed of yam cv. *Guinea Negro* was completed using a Temporary Immersion Bioreactor System and the protocol was validated. Producers have been trained in the process of selecting high-quality seed and post-harvest storage and pathogen management.

Avocado and breadfruit are also crops with strong consumer demand in PR for which there is ample room for growth to substitute imports. Research results on the combined effects of fertilization and phytostimulators on the growth and yield of these crops can help growers decide which practices are best suited to their interests and may help reduce wasteful and potentially polluting use of fertilizers in these crops.

A major goal of the UPR bean breeding program is to develop locally adapted bean cultivars that can be used to increase food security. An important source of vegetable protein are common beans and pigeon peas. Germplasm releases of UPR-Mp-23, UPR-Mp-34, UPR-Mp-42, and UPR-Mp-48 were achieved, with improved resistance to *Macrophomina phaseolina* for use in breeding programs. In common beans as well, three QTL on chromosomes 3, 7, 9 were identified to confer resistance to *M. phaseolina*. Markers have been used to identify genes/QTLs associated with biotic and abiotic traits in Phaseolus genotypes. Also, alternative strategies of control of Lepidoptera species, major pests in pigeon pea and sweet corn, using biological agents alone and in combination with low toxic synthetic insecticides were evaluated.

Regarding pigeon pea breeding, a new pigeon pea cultivar '*Isabella*' with higher yield and early maturity was released. White bean cultivars '*Bella*' and '*Beniquez*', released by the UPR-AES, expressed high levels of resistance to root rot caused by *Fusarium solani*. The Mesoamerican pink bean line PR1519-25 has multiple virus resistance, erect plant type and a mean seed yield > 2,500 kg/ha over seven planting dates. It was released as '*Rosalinda*'. Snap bean, black, small red, red mottled and yellow bean breeding lines with multiple virus resistance have been selected.

Finally, plant varieties better adapted to organic systems have been already identified and recommended to organic or agroecological farmers. A preliminary profile of PRAEXS organic farms stakeholders was prepared and presented in an international social science conference.

Progress has also been achieved in the strategies adopted to increase animal production in warmer climates through the study of a slick hair phenotype and through the evaluation of tropical improved grasses. In Puerto Rico, dairy cattle carrying a slick hair gene appear to be an adaptation of cattle to heat stress conditions. Improving knowledge of the Puerto Rican slick-haired cattle is essential for precise selection of animals, and subsequent increase in efficiency of milk on dairy farms.

Previous studies on the characterization and relationships of growth patterns, eating behavior and health in slick and wild type haired Puerto Rican Holstein calves and heifers have shown greater thermoregulatory and productive capacities of the slick haired phenotype cattle compared to the wild type. Current research and extension efforts include the evaluation of using an automated milk feeder to deliver an accelerated growth feeding protocol on the weight gain and future milk yield in slick and wild-type Holsteins calves.

Experiments have been performed on estrus and pregnancy rates and ovarian steroid concentrations after estrus synchronization and throughout pregnancy, and to determine if gene expression differences exist in the liver of slick hair and wild type heifers. Preliminary results show there are detectable differences in gene expression that may indicate that the slick cow is more fertile than the wildtype when exposed to tropical warm weather.

Studies of the performance of improved forage species in local environments already have results that have been used by Extension to provide specialized technical advice to farmers. The best grasses varieties have been identified for the different agroclimatic regions of Puerto Rico. The best soil preparation techniques, amount of seeds per acre and fertility recommendations, have also been developed based on research results.

PRAES efforts continue focusing on educating our farmers and ranchers through traditional and non-traditional educational activities to improve the quality of their products through the proper management practices that contribute to increasing production, competitiveness, efficiency, and biosecurity in their enterprises. Pertaining to Animal Systems, a total of 111 educational activities were provided to ranchers with 948 people benefiting from these and 75 reporting to adopt at least one recommended practice. In the last years, an increased interest in bee keeping has been observed and reflected by the increased number of educational activities in apiculture (i.e., 33.3 % of the total trainings under animal production). The proportion of educational activities in beef and dairy cattle reached 31.5 and 19.8 % of the total activities in animal systems, respectively.

Although PRAES did not report significant progress in the defined NRS Extension programs, progress was achieved in joint efforts with PRAEXS. Examples of this included research and outreach about neonate feeding strategies to improve bovine productive efficiency under tropical conditions. Additional efforts included evaluation of improved tropical forage species, destined to feed cattle, that result in the best economic benefit to our farmers. Among the factors considered in this study included the best agronomic management practices to produce improved forages considering the different agroclimatic regions of Puerto Rico.

Regarding Plant Systems, a total of 141 educational activities were provided to farmers with 4,168 people benefiting from these and 250 reporting to adopt at least one recommended practice. Vegetables, farinaceous and non-citrus fruits continue to be the areas most demanded for training, accounting for 72.34% of all the educational interventions provided to our farmers For FY2022, a new PRAES program was created and focused on adding value to the coffee produced in Puerto Rico. Educational activities and follow up visits were centred in providing producers the adequate managements practices at the pre- and post-harvest level to improve the quality of their coffee. Additional training provided recommended marketing strategies to improve their competitiveness in the market and generate an economic benefit.

#### **Critical Issue: Positive youth development**

Prior to the pandemic, youth of Puerto Rico were struggling with challenges related to poverty. Moreover, the pandemic dramatically impacted youth's mental health and academic performance. The lack of educational opportunities and access to health services and food, mainly due to the closing of schools, exacerbated our youth precarious situation. Of particular concern was knowing the vulnerability of Puerto Rican youth to homelessness, including some of our 4-Hers. PRAES is assisting our youth by providing tools to complete high school, prepare and motivate youth to undertake the actions of social justice and economic development. Also, PRAES is fighting against the risk of homelessness among college students by promoting access to fresh food, packaged food, health education experiences, and other services with the support of community-based organizations.

Through interdisciplinary initiatives that integrate 4H members' needs and PRAES program objectives, Extension personnel has assisted our youth through the new program entitled Teens leading the change for community wellness. Some of these initiatives included activities to 1) connected our children and youth with apiculture as an agriculture field that provided scientific knowledge, careers opportunities and entrepreneur alternatives, 2) training to 4H members about healthy living lifestyles and production of food at home and schools, 3) provide spaces to reflect and work about inequities that predispose people to homelessness and 4) educate our 4-H youth in an inclusive place for deaf and blind youth. The most salient achievements of these initiatives are highlighted in the results (4-H: an inclusive space that provides opportunities for children and youth), including:

- Ruta 4-H:
  - 1,294 participants completed non-formal education in healthy lifestyles.
  - 35 youth leaders trained to broaden the educational reach of healthy lifestyles.
  - 5 youth leaders represented Puerto Rico at the Healthy Living Summit 2022.
- ACCESO:
  - Benefited more than 75 homeless people, by receiving articles and food collected in 4-H DropBOX stations.
  - 4-H leader (n=6) provided workshops about general hygiene and hand washing and offered time to organized food storage at homelessness center.
- The Bug Camp:
  - Kids and youth learned about related professional careers in entomology and the role of insects in food production, environmental diversity, and their impact in reducing world hunger.
  - 15 participants completed camp activities and five extension educators served as mentors.
- 4-H Bee Team:
  - 15 4-H participants completed 45 hours of education and practices related to apiculture.

- 5 participants served as peer educators in Pollinators Fairs, in school activities and at the Agri-Innovation Week by Corteva Agriscience.

- Explora
  - 4-H participants (n=56) explored career opportunities and strategies to better face the challenges related to college life

## Merit and Scientific Peer Review Processes

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### Updates

NONE for PRAEXS and PRAES.

## Stakeholder Input

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### Actions to seek stakeholder input that encouraged their participation with a brief explanation

NONE for PRAEXS and PRAES.

### Methods to identify individuals and groups and brief explanation

In addition to the methods described in our POW, PRAEXS commodity and program leaders and associated faculty have created Facebook pages to disseminate activities and relevant commodity information. Interested stakeholders making contact through this and other social networks are also invited to attend commodity meetings where needs and priorities are assessed.

### Methods for collecting stakeholder input and brief explanation

Several PRAEXS commodity and program leaders have conducted more formal surveys of stakeholders needs, priorities and concerns, complementing in this manner the information collected through personal communications and evaluation forms distributed at the end of meetings and workshops.

The PRAES Planning and Evaluation Office in conjunction with the Extension Assistant Dean and the Extension Programmatic Leaders updated its survey to collect stakeholder input. The updated survey allows the participants to report their needs considering the Educational Activities integrated into the four Extension Programmatic Areas (i.e., Agriculture and Natural Resources, Positive Youth Development, Community Economy and Sustainable Development, and Family and Well-Being). For example, a Farmer can report a need pertaining to its farm that could be addressed by improving the situation of the community where the farm is located. In addition, the survey now can be sent online or via text message or in paper (the latest particularly helpful for rural areas).

### A statement of how the input will be considered and brief explanation of what you learned from your stakeholders

Stakeholder input was used to justify a recruitment plan for new faculty with partial research appointments at the PRAEXS, submitted to the Mayaguez Campus Chancellor and UPR's President last year. Needs identified by stakeholders and advanced in this plan included recruiting faculty with expertise in cropping systems and climate change interactions, precision farming, agricultural economics/agribusiness and marketing, and farming under structures or protected agriculture.

In addition, as described in our POW, seven new Hatch projects aligned with priorities identified by stakeholders were initiated last year in areas such as integrated pest management in roots and tubers, formulations for value added fruit products, vegetable production under high tunnels, and low-cost sustainable practices for the production of food crops, among others.

Lastly, an internal assessment of our priority-setting process is currently being conducted by PRAEX research administration in response to stakeholders concerns with the long list of priorities gathered by our current system.

PRAES established a new committee comprising of the Director of the Planning and Evaluation Office, the Extension Planning and Evaluator Specialist, and the Community Economy and Sustainable Development Program Leader. The committee hired a graduated student, specialized in statistics, and using the data collected, descriptive statistics are performed to better address the stakeholder input. The committee will distribute the results along with recommendations to all the Extension Personnel to better address the needs, employing an integration approach among the four Extension Programmatic Areas.

## Highlighted Results by Project or Program

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### Critical Issue

### Community, economy & sustainable development

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#### Community self-management, economic development, and volunteers' resilient projects during critical times.

Project Director

Jaime Curbelo

Organization

University of Puerto Rico Mayaguez Campus



## Development of community enterprises to create vibrant communities

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### In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Puerto Rico continues to experience an economic recession for more than a decade. The social and economic vulnerabilities already present in the island are expected to increase soon by the cumulative impact of all the recent phenomena that the Island has experienced. Puerto Rico needs to improve its food security and generate income-producing alternatives that can significantly increase the recovery prospects of its communities.

### Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

During this period, we implemented two awards to boost the development of community enterprises to increase food self-sufficiency. The NRCS USDA sponsored an award to educate community organizations about agroecological systems as a resilient management strategy and community enterprise. The project awarded seven community organizations to implement approximately 11 community gardens. The community organizations, with collaboration of Extension personnel, developed organizational plans to build plant stand beds, composting facilities, and irrigation storage reservoirs. They also acquired materials to build the garden sites with the help of their organized volunteers. The project was aimed to start generating income in six months by selling products and services with the use of the new facilities.

The second award was awarded by the NIFA Distant Education Program. The grant provided funding to organize 5 educational centers to train communities about aquaculture systems and marketing. For the project to be sustainable, training about the development of alliances and production and marketing strategies to create the favorable conditions to supply fish to local schools.

As part of our vision, the projects are being developed using the fundamentals of solidarity economy as a guide to reach sustainable development. The projects required that members of the organization raise their capabilities regarding project management (finance, marketing, and accounting) enhancing and building new skills to organize their community enterprises activities through building capacity workshops. Awards provided more than \$75,000 to build the necessary infrastructure. At this moment, the community organization has made a great job restructuring and reorganizing their volunteers time. It has been possible to create greater capacity in new topics, demonstrating the capacity of the participants to be trained in new skills and to organize themselves, improving their community self-management.

### Briefly describe how your target audience benefited from your project's activities.

As part of the educational activities done through the initiatives, achievements reported from follow-up visits include:

- 78 leaders actively participated in the design and development of community projects.
- 23 communities took actions to meet their needs to improve their quality of life through empowerment and community self-management.
- 21 government agencies or other organizations collaborated in the development and organization of the community.
- 204 people collaborated as volunteers.
- 245 hours dedicated through volunteer work as community leaders.
- 2 communities were organized for the preservation and conservation of coastal resources and other natural resources.
- 10 action plans were developed and updated by community members to address a problem.
- 10 coalitions or support networks established in the community.

Particular successes as result of extension contribution through training related to community self-management, economic development, and volunteers' resilient projects include:



#### **Community Development Initiative:**

Mrs. Oquendo, a single woman, businesswoman and owner of an online Jewelry store in Arecibo wanted to expand her store to better provide her family. Through the assistance of extension personnel, she drafted a proposal to incorporate her store into the Morovis Tourism and Culture store. Her proposal was approved and now she sells part of her inventory in the Tourism and Culture store. Oquendo expressed that thanks to the knowledge acquired through Extension, she has managed to improve her business strategy and sales. Her enthusiasm continues to improve her business. The help provided by Extension personnel improved the quality of life of Oquendo and her family because she is now an autonomous mother. She has used her success story and knowledge further to train and support other mothers and women to undertake and seek a livelihood for her families just like her.

#### **Community Garden Initiative:**

The preparation of a community emergency management plan and the organization of volunteer leaders from the municipality of Ponce, led to the preparation of a community census to assess the physical and structural needs of the community. Using this information, the community profile was prepared, and fundraising efforts were organized, which led to the purchase of emergency supplies and equipment for road cleaning. Home gardens (4) and farms (2) in the community increased their diversity and production by adopting practices such as IPM, pruning, and composting. After Hurricane Fiona, the community-owned school canteen was opened, where 5 volunteer leaders prepared breakfast and lunch for the community for three weeks. A total of 2,400 plates of food and 150 non-perishable food purchases were served, impacting more than 100 families in the area. All this in collaboration with Ponce Neighborhood and Hispanic Federation.

#### **Briefly describe how the broader public benefited from your project's activities.**

The program's goal is to provide knowledge and tools that allow our target audience to better address issues related to economic development, self-management, leadership, and volunteering. By improving the economic situation of our participants, we are helping to improve their communities as well, therefore indirectly benefiting other individuals. With the Extension contribution to community organizations helped develop the local food economy and therefore broader public benefited from having fresh and nutritious sourced food nearby.

#### **Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.**

With the collaboration of field staff, we recently formed three new working groups to promote volunteering, emergency planning and community business incubators.

#### **Consumer attitudes and behavior towards differentiated products in Puerto Rico: An assessment of text, labels and quick response (QR) codes**

Project Director

Hector Tavarez

Organization

University of Puerto Rico Mayaguez Campus

Accession Number

1021265



#### **Annual Results-Consumer attitudes and behavior towards differentiated products in Puerto Rico: An assessment of text, labels and quick response (QR) codes**

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#### **In 2-3 sentences, briefly describe the issue or problem that your project addresses.**

This project seeks to use data from questionnaires to evaluate consumer attitudes and behavior towards text, logos and quick response codes in packages of differentiated coffee and in containers of differentiated milk. The study also seeks to use a variety of strategies to disseminate research results to stakeholders at multiple levels.

#### **Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.**

We worked on the overall design of product packages, logos and videos necessary for the survey design. We distributed surveys through in-person interviews at multiple municipalities. Coffee and milk data were successfully collected by 3 interviewers who received training on data collection.

#### **Briefly describe how your target audience benefited from your project's activities.**

We have been publishing the results using a variety of dissemination strategies. Stakeholders and farmers can benefit from this study in the future if agricultural policies are legislated as a result of this study.



**Briefly describe how the broader public benefited from your project's activities.**

Students, professors, and farmers are aware of the results of this study. Future studies can extend this research to other agricultural crops. Farmers can use the results of this study to commercialize differentiated products. In fact, the results of this study could be applied to other sectors of the economy, beyond agriculture.

**Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.**

**Training and professional development opportunities** - We organized two seminars oriented to students. The first seminar focused on survey design and distribution. The second seminar was oriented to data entry and data analysis.

**Dissemination of results**-Although we presented study results in different locations, these efforts were completed after September 30, 2022.

**Plans for next reporting period** - This project ends in September 2023. We presented study results at SOPCA and we plan to present study results in the annual meeting of the coffee and milk sectors organized yearly by the College of Agricultural Sciences of the University of Puerto Rico. We also plan to present study results in the 60th annual meeting of the Caribbean Food Crops Society, which will be held in Grenada in July 2023.

**Publications:**

Tavárez, H., Cortés, M., & Hernández, J. (Submitted). Consumer attitudes and behavior towards differentiated products in Puerto Rico: An assessment of text, logos and quick response (QR) codes. *Economía Agraria y Recursos Naturales*.

Tavárez, H., Cortés, M., & Gregory, A. (pending). Preferencias de los consumidores por leche producida asegurando el bienestar animal en Puerto Rico. *Journal of Agriculture of the University of Puerto Rico*

**Other Products:**

**Activities:** We collected data from survey distribution. The data was analyzed accordingly.

**Events:** Students received training on data analysis using the dataset generated from this study.

**Product:** We are using resources from other project to construct a website to store databases from multiple projects. We are working on the dataset of this study. Data generated from this study will be freely available to anyone interested in this study.

Critical Issue

## Extreme weather, environment, natural resources, and sustainable energy

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### Natural resource protection amid extreme weather and natural disasters

Project Director

Jaime Curbelo

Organization

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7002484



**Mitigating the impact of climate change on agricultural production by improving agricultural practices, supporting soil and water conservation, and encouraging composting.**

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**In 2-3 sentences, briefly describe the issue or problem that your project addresses.**

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. As the world continues to experience the effects of climate change, no group will be impacted more than farmers, and each growing season seems to come with more challenges than the previous. Prime agricultural land is a limited resource on the island and is constantly threatened by urbanization and soil erosion. Though Puerto Rico's agriculture is very diverse, characterized mainly by small family production units, the effects of land degradation without mitigation strategies will become insurmountable in the near future.

**Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.**

The activities and educational efforts during 2022 associated with the critical issue Extreme Weather, Environment & Sustainable Energy were focused on mitigating the impact of climate change on agricultural production by improving agricultural practices, supporting soil and water conservation, and encouraging composting. Instruction and service to farmers and other stakeholders across the island were made through

various in-person and virtual trainings.

Six workshops covering soil sampling, soil analysis interpretation, and nutrient recommendations were provided for the agricultural agents that cover municipalities across the island. In addition, 15 trainings on soil management and fertility were offered with 75 farmers attending. Soils from 30 farms were sampled, analyzed and the results were discussed with farmers providing the appropriate recommendations. Collaborations between PRAES and NRCS resulted in the dissemination of soil nutrient management information to farmers, producers and the general public.

Educational efforts on soil erosion control have continued to increase awareness of soil resource conservation and agricultural resilience due to climate change. These included training workshops on watershed protection, water harvesting, and storage that have been offered at extension offices and in the field. Eighteen individuals were trained in the protection of water quality and conservation of watersheds near agricultural farms, 36 individuals were trained in soil erosion control and soil health, and 24 individuals were trained in rainwater collection, storage and reuse in the farm.

Climate change is one of the most significant challenges that Puerto Rico is facing today. Workshops focused on improving agricultural resiliency and the protection and conservation of natural resources were provided using the established PRAES curriculum guide “Climate Change: Impact on agricultural production and methods of adaptation” with a total of 93 individuals in attendance.

### **Briefly describe how your target audience benefited from your project's activities.**

#### **Soil management and conservation**

Soil conservation and nutrient management training resulted in the adoption of practices and recommendations that have improved the conditions on more than 45 farms. Eleven farmers incorporated the use of soil amendments based on soil fertility results. Eight farmers changed their fertilizer formulations to more closely coincide with the needs of the crops grown. Fifty-two individuals adopted recommended conservation practices to effectively manage the soils on their farms.

One success story involved a new eggplant farmer in Isabela. The farm was previously dedicated to forage for cattle and was not in the best conditions. After several visits, trainings, and recommendations from the local agricultural agent the farmer was able to reduce his fertilizer application by 75% while maintaining vegetable production. Through the various visits he also learned about the importance of plant nutrition, how to read soil test results, how to recognize beneficial insects and practices to control for plant pests. He is currently in the process of starting a second farm.

#### **Agricultural resilience and natural resource protection due to climate change**

More than 15 individuals/farmers adopted practices that will improve agricultural resilience and natural resource protection in the face of climate change. Four farms implemented or improved water collection systems on their properties while three farms prepared contingency plans and obtained agricultural insurance in case of natural disasters. Three adult volunteers collaborated in activities to prepare for extreme weather events.

Two natural resources conservation initiatives worth mentioning occurred in Ponce, Puerto Rico. The first focused on urban forestry and green area conservation. Ninety-nine youth from the city of Ponce participated in planting 137 trees at an important local recreational park (Luis A. Wito Morales Crespo park). A manual on the management of forest resources in peri-urban zones was developed as one of the project objectives and will be used for future trainings. The second project involved the cleaning of coastal areas. Ninety-five youth, 4 adult volunteers, and 3 forest rangers collected trash, filling over 100 bags, from the Punta Cucharas Natural Reserve. The youth learned about the natural resources of the area, proper waste management, and the benefits of working as a team.

#### **Composting**

The training on composting at home for the communities in Fajardo resulted in four families now composting materials from their kitchens to provide nutrients to their home gardens. One farmer also adopted composting practices on their farm in the reuse of crop residues.

### **Briefly describe how the broader public benefited from your project's activities.**

The project's goal is to mitigate the effects of climate change on agricultural production by increasing the use of sustainable agricultural practices that protects Puerto Rico's natural resources. The broader public benefit directly from a more sustainable local food source and indirectly from the protection of natural resources that provide raw materials, fuel, recreation, and aesthetics to the island.

#### **Microirrigation: A Sustainable Technology for Crop Intensification and Improved Crop Productivity**

Project Director

Elvin Roman-Paoli

Organization

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