UNIVERSITY OF GUAM
UNIBETSEDÅT GUÅHAN

UNIVERSITY OF GUAM
LAND GRANT

IMPACT REPORT

2024 RESEARCH & EXTENSION

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Cover photo: Researchers apply biochar to the soil at UOG's agricultural experiment station in Yigo.
Right: Wasp nest in Saipan *Photos by Keanno Fausto*

MESSAGE FROM THE DIRECTOR

Buenas yan Håfa Adai!

As the University of Guam through the College of Natural & Applied Sciences continues to deliver on its Land Grant mission of 52 years, we are pleased to share an exciting portfolio of work for 2024. This is a first-time combined research and extension report, delivering impact stories from our newly renamed agInnovation Research Center and UOG Extension Service. Together, these teams pursued science-driven, community-focused solutions to Guam's most pressing agricultural, environmental, economic, food, and health challenges. Rooted in our island's unique ecosystems and needs, the work we highlight this year reflects deep collaboration across disciplines, villages, and the region.

Our researchers made critical discoveries in both terrestrial and marine environments. Dr. Glenn Dulla's team documented two firsts for Guam: a micromoth infesting mangrove seeds in Sasa Bay, threatening coastal regeneration, and the presence of *Labyrinthula* spp., a pathogen causing seagrass wasting disease. Both findings lay the foundation for future conservation and biosecurity protocols. In parallel, Dr. Ross Miller and Guam's beekeepers advanced low-cost, locally developed traps and guards to defend honeybee colonies from the invasive *Vespa tropica* hornet. Research by Dr. Sahena Ferdosh revealed that the invasive "chain of love" vine contains beneficial phytochemicals with nutraceutical potential. Meanwhile, Dr. Jeng-Hung Liu's analysis of feral swine meat opens new conversations about sustainable local protein sources.

Innovation in sustainable agriculture also surged. Grafting workshops trained 150 growers in mango propagation; sheet mulching proved to be an effective way to increase crop yields and reduce weeding labor; and a biochar project showed how soil amendments can boost yield while lowering carbon emissions.

Our extension projects saw strong impact as well. The *Prevent T2* program helped participants reduce diabetes risk, while the *Family Resiliency Program* reached more than 170 residents with education in healthy aging, financial literacy, and life skills. The *Farmer Focus* initiative brought mental health resources to rural communities and certified 59 in Mental Health First Aid. And our team also provided essential support for carrying out the every-five-year *Census of Agriculture* in Guam.

We strongly believe in the Land Grant mission, and this report shows why. Our work exemplifies the power of science grounded in island wisdom. Please reach out to our researchers at the emails provided if you're interested in knowing more.

Rachael T. Leon Guerrero, Ph.D., RDN
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MESSAGE FROM THE ASSOCIATE DIRECTOR OF RESEARCH

Håfa Adai!

This year marks a major milestone for Land Grant research at the University of Guam. After more than 20 years as the home of UOG's agricultural experiment station, the Western Pacific Tropical Research Center has been rebranded as the agInnovation Research Center – a name that reflects a renewed focus on innovation and relevance in addressing the agricultural challenges of Guam and Micronesia.

Land Grant faculty continue to lead impactful research that safeguards our natural resources, enhances quality of life, promotes economic development, and strengthens food security in our region. Recent efforts include combating invasive species that threaten local ecosystems and agriculture. UOG researchers have collaborated with beekeepers to develop traps and barriers that protect hives from the destructive Greater Banded Hornet (*Vespa tropica*). Other innovative projects are exploring potential benefits from certain invasive species, such as identifying medicinal phytochemicals in the chain of love vine (*Antigonon leptopus*) and studying wild pig meat as an alternative protein source.

Our scientists are also active participants in Multistate Hatch projects, collaborating with peers across the U.S. Land Grant system to address regionally and nationally significant issues. One such project, through the Children's Healthy Living Network, is assessing food access and security for children in the U.S.-affiliated Pacific Islands. Another is focused on exploring the genetic diversity of Guam's iconic hot peppers – preserving culturally important traits and deepening our understanding of their origins.

Looking ahead, the agInnovation Research Center is well-positioned to remain a leader in sustainable food production and natural resource conservation. Our Land Grant programs remain driven by the needs of our communities and remain responsive to emerging opportunities, including those linked to Guam's ongoing military buildup. A key component of this enterprise is the support from our federal grantors, most especially the U.S. Department of Agriculture's National Institute of Food & Agriculture (USDA NIFA) and its research capacity grants.

We thank you for your continued support as we advance research that serves the people and environments of the Western Pacific and the nation.

Frank A. Camacho, Ph.D.
Interim Associate Director
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MESSAGE FROM THE ASSOCIATE DIRECTOR OF EXTENSION

Greetings,

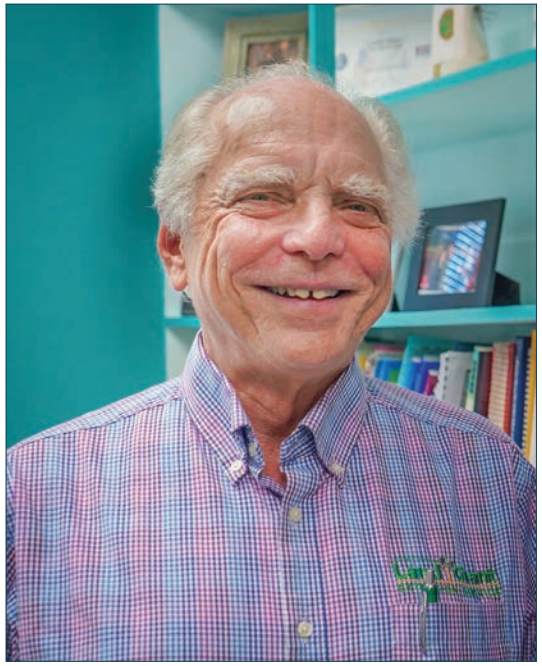
As the primary outreach arm of the University of Guam's Land Grant programs, the UOG Extension Service connects university expertise directly to our island community. Across agriculture, natural resources, food and nutrition, and family and community development, we work to ensure that our programs are driven by local needs and priorities, rooted in research, and focused on creating meaningful impact.

A defining hallmark of strong extension work is that it begins with identifying community needs. From there, we build collaborative partnerships and apply research-based solutions through accessible education. The extension projects highlighted in this report illustrate this model of delivering practical, engaging, and responsive programs that reflect the diverse needs of Guam's people.

In agriculture, our hands-on farmer trainings and home-gardening workshops have responded to a renewed community interest in food self-sufficiency and land use. Our Subsistence & Small Acreage Farmer Training Series, for one, taught both new and seasoned growers to apply sustainable, low-input farming methods rooted in traditional island agroforestry. Another example is our mango tree grafting workshops, which have started to address a need in the agricultural market on island for improved fruit quality.

In health and nutrition, we introduced the *Nihi Fanmama'tinas* (Let's Cook) cooking classes, which simultaneously respond to increasing disease risk in the community and support local agriculture by teaching nutritious recipes using Guam-grown produce. In our Family Resiliency Program, we have initiatives targeting life skills for all ages – from teen financial literacy workshops to senior center presentations on healthy aging.

These efforts build on our long-standing community education programs like SNAP-Ed and EFNEP, which maintain a trusted and impactful presence in schools, grocery stores, and early childcare centers island-wide.



Looking ahead, we're excited to welcome new extension faculty in key areas such as entomology, plant pathology, 4-H and youth development, and community engagement. This growth will expand our capacity to support our island's evolving needs with deeper expertise and broader reach.

We invite you to engage with us. Whether through taking a workshop, offering feedback, or joining a program, your involvement helps ensure that our work continues to be relevant, responsive, and rooted in Guam's values.

L. Robert Barber Jr., Ph.D.
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UOG LAND GRANT SYSTEM

INSTRUCTION

RESEARCH

EXTENSION

The University of Guam is one of 112 federally designated Land Grant universities. The UOG Land Grant units, housed within the College of Natural & Applied Sciences, works to generate and share knowledge in two areas that are relevant and applicable to every community member – living well from the land and in the home.

The Land Grant priorities include topics in agriculture, food and nutrition, natural resources, and family and consumer sciences. We explore and promote these topics through a research division, an extension (community outreach) division, and an academic instruction division.

ABOUT THE AGINNOVATION RESEARCH CENTER

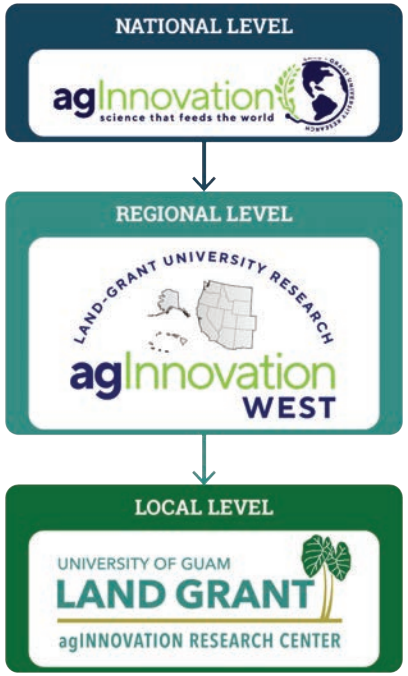
The agInnovation Research Center of the University of Guam Land Grant works to advance knowledge and investigate improvements for Western Pacific communities in the following areas:

- sustainable tropical agriculture production
- agricultural systems
- food science
- nutrition and health
- environmental stewardship
- energy and bioproducts
- climate resilience
- youth, family, and community resilience.

Our research is conducted on three agricultural experiment stations, which each have a different soil type common in Guam, as well as in the Guam Aquaculture Development & Training Center in Fadian, and in 10 on-campus research labs.

Affiliation and funding

The UOG agInnovation Research Center is an affiliate of agInnovation – the national parent organization for agricultural experiment stations at Land Grant universities in every state and territory. These stations, comprising 13,000 scientists nationwide, are federally funded through the Hatch, Multistate Hatch, and McIntire Stennis programs administered by the National Institute of Food & Agriculture of the U.S. Department of Agriculture.



OUR AGRICULTURAL EXPERIMENT STATIONS

Inalåhan Research & Education Center
Est. 1975
10.6 acres

The Inalåhan experiment station is the center's smallest station, representing the least common soil type in Guam. Bottomland, or strandline, soil is found in between the northern limestone soils and the southern volcanic soils of Guam and is deep, slow-draining, and silty or sandy in composition.

The station has a small plantation of 12 banana varieties, including some of the most popular varieties in Guam, used as a source of planting material for farmers and to teach students about plant propagation.

Ija Research & Education Center
Est. 1978
65 acres

With only rolling hills of red clay and wilderness in sight from the property, Ija station supports projects exploring agriculture techniques for the sloping, erosion-prone, and predominantly clay soil.

Ija station also has an orchard of mango trees that provides a valuable opportunity for improving mango fruit production on the island. The orchard includes 29 varieties from major mango-producing regions of the world and includes many of the most successful varieties in international commerce.

Yigo Research & Education Center
Est. 1986
47 acres

The Yigo station is located on the northern part of Guam on the soil type that covers approximately 30 percent of the island. The porous limestone in the north of Guam quickly absorbs water, and the shallow, "cobbly clay" soil tends to lack a good nutrient balance.

This makes the station ideal for research projects looking to make efficient and economical use of nutrients, such as the use of biochar and organic waste compost as soil amendments.

MEAT QUALITY STUDY REVEALS THE LIMITATIONS AND POTENTIAL OF FERAL PORK

Project Title: The quality of pork from feral swine in Guam
Lead Researcher: Jeng-Hung Liu, Ph.D. | liuj14031@triton.uog.edu
Timeframe: March 2025 – December 2024

Feral pork in Guam was found to be significantly darker, leaner, and tougher than domestic pork.

Relevance: Feral swine are considered a major pest in Guam, causing significant damage to local farms and ecosystems. Pork is deeply embedded in local culture and cuisine, and although feral swine is hunted and consumed, most consumers rely on imported domestic pork. Little research has been done to examine how feral pork compares in quality to its domesticated counterpart.

A research-based assessment of feral swine meat quality could inform potential uses of this available natural protein source and its potential contribution toward food security for the island, whether for human consumption or as feed for poultry or aquaculture. Additionally, knowing the strengths and limitations of feral pork from a consumer standpoint can inform hunters of strategies to make the meat more palatable as well as chefs on more effective cooking techniques.

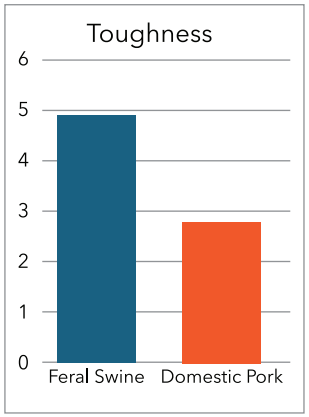
Response: To assess the unknowns of Guam's feral swine meat, animal scientist Dr. Jeng-Hung Liu of the University of Guam Land Grant's agInnovation Research Center conducted a pork quality comparison study. The study analyzed three critical factors — color, marbling, and tenderness — in 82 pork samples from feral swine in Guam, supplied by USDA Wildlife Services Feral Swine Team, and 100 domestic pork chops from local grocery stores.

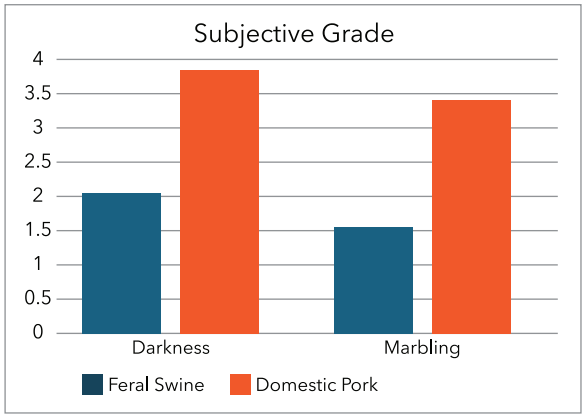
The laboratory assessment of the meat samples included:

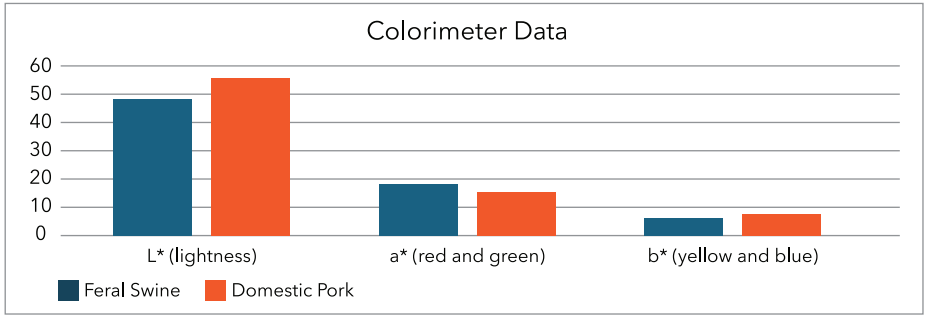
- Grading pork color using National Pork Producer Council standards and a colorimeter.
- Scoring marbling (fat within muscle) on a 1–10 NPPC scale.
- Measuring tenderness using the Warner-Bratzler Shear Force (WBSF) test.

Results: The research team found the following:

- **Color:** The feral pork had a darker appearance than domestic pork with a value of 49 (darker) versus 56.
- **Marbling:** The domestic pork had nearly double the marbling score of the feral pork with values of 3.31 (more marbling) vs. 1.56.
- **Tenderness:** The domestic pork was significantly more tender, with a WBSF of 2.77 (more tender) versus 4.92 for feral pork.







Research assistant Ashley Yip prepares cuts of feral swine meat to be tested for color, marbling, and tenderness. *Photo by Mia Alvarez*

The differences are largely attributed to the controlled diet, genetics, and age of domestic pigs compared to less predictable development of wild hogs, which contributes to the wild hogs being leaner.

The findings highlight both the limitations and potential of feral pork. While wild hog meat is leaner and tougher, potential improvements made to the hogs' diet and rearing could make their meat more competitive with domestic pork. This could eventually encourage a food security initiative related to the sustainable rearing and hunting of feral swine.

Next Steps: The findings are being prepared to submit to a peer-reviewed journal. Future research will compare domestic pork vs. feral swine in more detail and how to further increase the consistency and quality of feral pork. Research might include using meat processing technology to further enhance the quality of the feral swine. The study also creates opportunities for consumer taste tests, nutritional profiling, and discussions about commercial viability.

Research Team: Ashley Yip, Todd Yip, Candice Estrada
Funding Source: Hatch Grant, U.S. Department of Agriculture

THE IMPACTS OF THE GREATER BANDED HORNET ON GUAM BEEKEEPING

Lead Researcher: Ross Miller, Ph.D. | millerr@triton.uog.edu
Timeframe: 2016 – Present

Relevance: The arrival of the invasive greater banded hornet (*Vespa tropica*) in Guam in July 2016 presented a significant ecological threat, especially to honeybee populations. The hornets target both domestic and wild bees, disrupting pollination activity and causing rapid colony collapse, sometimes within 24 hours.

Beekeeping is growing in popularity in Guam as an agricultural enterprise. The Guam Beekeepers Association is now at 120 members, and at least five large apiaries on island are commercially producing honey and related products, with a number of other beekeepers producing on a smaller scale. The invasion threatens the livelihoods of both commercial and backyard beekeepers as well as consumers who wish to support local farmers and enjoy locally produced versus imported honey.

The Guam Department of Agriculture reports 45 total greater banded hornet colonies have been removed on island, though the hornet will likely not be able to be completely eradicated. Around 15 beekeepers have reported total hive losses, while many more hives have been affected by frequent attacks, reducing foraging and productivity.

Response: In response, members of the Guam Beekeepers Association, with support and guidance from entomologist Dr. Ross Miller of the University of Guam Land Grant's agInnovation Research Center and Guam state entomologist Chris Rosario from the Guam Department of Agriculture, have developed two low-cost, easy-to-implement tools:

1. **Hornet excluder guard:** A quarter-inch mesh screen installed at hive entrances, small enough to prevent hornet entry while allowing honeybees to pass.

> Guam has the first known ecological conflict between the greater banded hornet and European honeybees in the Pacific Basin, creating a frontline case for management.

2. **Hornet traps:** Modified minnow-style traps, also covered in quarter-inch mesh, that are baited with honeycomb. These are simple frames designed to confuse and contain hornets after entry.

These innovations emerged from grassroots efforts by local apiarists like Charlie Pool, who started experimenting with solutions following major hornet-related hive losses. The designs have been refined over time to keep pace with hornet adaptability. Outreach efforts have included workshops to teach apiarists how to build the traps and resource-sharing within the beekeeper network.

A greater banded hornet is kept out of a honeybee hive with a quarter-inch mesh guard. *Photo by Chris Rosario*

Results: Guam's ecological conflict between *Vespa tropica* and the European honeybee is a first-time case in the United States and the Pacific Basin. The researchers and participating beekeepers have learned more about the problem through observation and the implementation of integrated pest management strategies.

Some of their lessons learned include:

- Hornet guards significantly reduce hornet predation and also give beekeepers a chance to kill hornets using fly swatters, salt guns, or other direct methods. Quarter-inch mesh screens seem to work best.
- Beekeepers must be vigilant. Passive beekeeping does not work in Guam's current environment. Beekeepers must do frequent hive checks and hornet killing. Relocating hives under attack has also proven effective.

(From left) Charlie Pool, Grant Hodgins, Ross Miller, and Chris Rosario hold a greater banded hornet trap and two beehive shields that were collaboratively developed since the greater banded hornet first impacted Guam's honeybees in 2017.
Photo by Jackie Hanson

- Weaker colonies are most vulnerable. Consolidating newer colonies with stronger ones, or moving a new colony to a location on island without hornets, has been effective.
- Traps baited with honeycomb can divert hornets from hives and allow beekeepers an opportunity to kill them. Funnel entrances with the wider opening on the outside of the trap increase trap success.
- Styrofoam hive boxes are vulnerable to hornet chewing and intrusion. More durable materials, including wood, marine plywood (termite resistant), and cement, have proven to be more effective.

Next Steps: Further studies on hornet behavior in Guam are planned, pending the availability of grant funding. Some studies under consideration include testing the success rates of different types of guards and traps and flight mill testing to determine the hornets' flight range. A graduate student has begun work using radio telemetry tracking to follow hornets to their nests, and a mainland-based USDA researcher is working on pheromone-based lures and traps.

Guam's experience and observations thus far with the greater banded hornet are especially relevant for neighboring islands in Micronesia and states like Hawaii and California, which could be severely impacted if the hornet spreads.

Next steps include:

- expanding hornet trap distribution and refining designs
- securing USDA and Western SARE funding for further research and IPM tool development
- increasing training opportunities for regional beekeepers.

Project Partners:	Chris Rosario, Guam Department of Agriculture Charlie Pool, Guam Beekeepers Association Grant Hodgins, Guam Beekeepers Association
Funding Source:	Internal community resources

MICROMOTH INFESTATION THREATENS MANGROVE SEED VIABILITY IN GUAM'S SASA BAY

Project Title: Investigating pest pressure on the mangrove tree *Lumnitzera littorea* in Sasa Bay in Guam
Lead Researcher: Glenn Dulla, Ph.D. | dullag@triton.uog.edu
Timeframe: September 2024 – Present

Infestation rates of up to 100% were found in seeds from individual *Lumnitzera littorea* trees, posing a serious threat to mangrove regeneration in Guam.

Relevance: In Guam's Sasa Bay Marine Preserve, the native mangrove tree *Lumnitzera littorea* (*ngånga'* in CHamoru) plays a vital ecological role, serving as a nursery habitat for aquatic species, stabilizing coastlines, and storing carbon. However, recent concerns arose as researchers noted that many of the tree's seeds failed to germinate. Low germination rates raised red flags, especially in light of similar findings in Sri Lanka, where micromoths were found to infest and destroy mangrove seeds.

This issue directly impacts fisheries reliant on mangrove habitats, broader public interests in climate resilience and biodiversity, and out-planting initiatives being undertaken by the Department of Defense to restore the mangroves. The potential for mangrove decline, particularly of the small population of *L. littorea* in Guam, due to pest pressure threatens both Guam's mangrove ecosystems and coastal infrastructure.

Response: A research team led by Dr. Glenn Dulla, a plant pathologist with the agInnovation Research Center of the University of Guam Land Grant, and Cara Lin, the seagrass and mangrove conservation coordinator with the Guam Coral Reef Initiative, set out to identify the cause of *L. littorea*'s low seed germination. Through fieldwork in Sasa Bay, the team collected seed samples and documented physical symptoms of pest infestation. The seeds were analyzed for the presence of insect frass, larvae, and pupae. Adult moths were reared for taxonomic identification at the USDA Systematic Entomology Lab. Identification of the pest and estimating the percentage of seeds affected were crucial first steps in addressing this threat.

Results: The study confirmed that a group of micromoths, likely from the *Parametriotinae* subfamily, is infesting *L. littorea* seeds. The pests caused 54% to 100% of seeds from individual trees to become nonviable. Adult moths' genital morphology matched those of the *Leptozestis* or *Trachydora* genera, neither of which has been previously documented in Guam or in association with this tree species.

This is the first known documentation of this micromoth affecting *L. littorea* in the Pacific islands. A similar micromoth was identified in *L. littorea* in Vietnam but of the genus *Gelechidae*. The findings are a critical step toward understanding the regional spread of mangrove pests. This study is essential for informing future biosecurity measures and ecological preservation efforts in Guam and beyond.

Next Steps: The team plans to expand the study to other mangrove habitats and mangrove tree species across Guam to determine if other tree species are similarly threatened. The insect is presumed to only be in Sasa Bay. Regional collaborations will help assess the micromoth's presence elsewhere in the Pacific. Further, researchers aim to sequence the pest's DNA for more accurate identification and to explore seed protection strategies to boost germination rates.

Research Team: Amber Pineda (Blue Carbon Ambassador Intern, UOG)
Jim D. Young (National Museum of Natural History, USDA National Identification Services)
Cara Lin (Guam Coral Reef Initiative, Guam Dept. of Agriculture)
Funding Sources: NOAA Coral Reef Conservation Program Cooperative Agreement (NA23NOS4820147)
Blue Carbon Ambassador Program, EarthEcho International

Main: Cara Lin observes seeds on a *Lumnitzera littorea* mangrove tree in Sasa Bay Marine Preserve, Guam. *Photo by Guam Coral Reef Initiative*

Inset: Micromoth pupa in the center of a dissected *Lumnitzera littorea* seed. *Photo by Cara Lin*

SEAGRASS WASTING DISEASE PATHOGEN IDENTIFIED IN GUAM

Project Title: Identification and isolation of presumptive *Labyrinthula* spp. in seagrass wasting disease in Guam tape grass *(Enhalus acoroides)* populations
Lead Researcher: Glenn Dulla, Ph.D. | dullag@triton.uog.edu
Timeframe: June 2024 – Present

Relevance: Seagrasses are essential to Guam's coastal ecosystems, providing a nursery habitat for fish, stabilizing shorelines, and sequestering carbon. These ecosystems are vulnerable to seagrass wasting disease (SWD), a globally recognized threat caused by *Labyrinthula* spp., unicellular protists responsible for large-scale eelgrass die-offs in the Atlantic. Symptoms of SWD include brown to black streaks on leaves. In Guam, past studies documented a 22% decline in seagrass cover from 2005 to 2015, yet the causes are not well understood, and disease-related research was never previously conducted.

Local fishers and coastal communities are directly affected by the health of seagrass beds, which buffer the shores and support several culturally important fisheries species. As climate change and habitat stressors increase, understanding and addressing disease threats to seagrass becomes critical to the island's ecological resilience.

Response: A team led by Dr. Glenn Dulla, a plant pathologist with the agInnovation Research Center of the University of Guam Land Grant, and Cara Lin, the seagrass and mangrove conservation coordinator with the Guam Coral Reef Initiative, launched the first local investigation into SWD in Guam's tape grass (*Enhalus acoroides*) populations, known in CHamoru as *lo'u*. Fieldwork involved snorkeling surveys in Hagåtña Bay and Achang Reef Flat Marine Preserve to collect symptomatic samples. The team then used conventional culturing techniques and molecular tools, including PCR, to isolate and identify potential pathogens.
The work marks the first effort of its kind to detect this pathogen in Guam's waters, laying foundational knowledge for understanding the cause of local seagrass decline, developing management strategies, and ongoing monitoring and response.

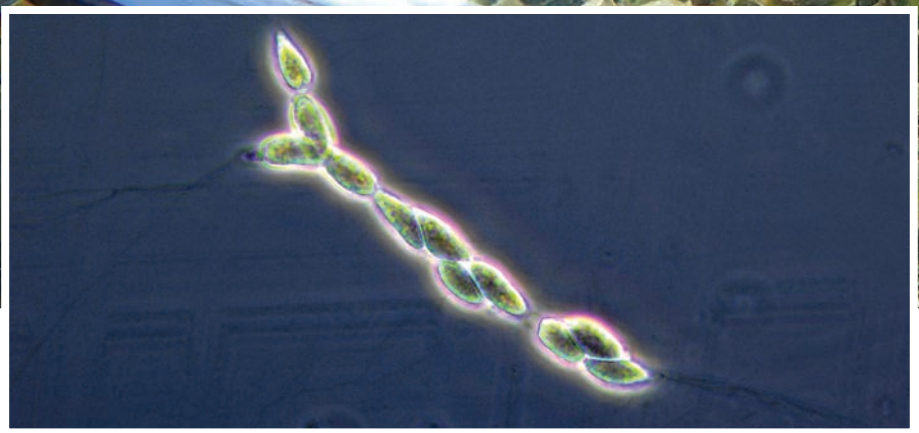
> Four strains of *Labyrinthula* — a known seagrass pathogen — have been found in Guam's waters.

Results: The researchers successfully isolated four strains of *Labyrinthula* from Guam's seagrass beds and confirmed their pathogenic potential through laboratory assays. Key findings include:

- Successful adaptation of PCR detection methods for pathogenic *Labyrinthula* using multiple primer sets.
- Microscopic evidence of cell tunneling and degradation in infected tissues.
- Microscopic evidence of motility on agar surfaces.
- Demonstration of Koch's Postulates, connecting *Labyrinthula* spp. to SWD.
- Visual categorization of tissue symptoms to aid future in-field disease diagnosis.

This is the first documented occurrence of *Labyrinthula* spp. in the Micronesian region and the first documentation in this type of seagrass, signaling a need for broader awareness and monitoring efforts across island and regional ecosystems.

Next Steps: The next phase involves mapping the extent of infection in Guam's seagrass beds and examining whether other, less dominant seagrass species are also affected. Researchers also plan to partner with regional agencies to train teams in identifying SWD and responding to outbreaks. These findings will support the development of early-warning tools and biosecurity protocols aimed at preserving seagrass habitats in Guam and throughout the Pacific.



Main: Cara Lin and Marie Auyong gather data on seagrass disease and density in Hagåtña Bay. *Photo by Sabrina Medina*

Inset: Spindle-shaped cells of *Labyrinthula* moving along their ectoplasmic net. *Photo by Glenn Dulla*

Research Team: Kylie Naguit (Student Intern, NASA Guam Space Grant, UOG)
Andrew Kang (Student Intern, John F. Kennedy High School)
Cara Lin (Guam Coral Reef Initiative, Guam Dept. of Agriculture)

Funding Sources: NOAA Coral Reef Conservation Program Cooperative Agreement (NA23NOS4820147)
National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health (Grant #5R25DK078386-18)
National Aeronautics & Space Administration (NASA Guam Space Grant internship)

GUAM'S MOST INVASIVE VINE MAY HOLD MEDICINAL VALUE

Project Title: Chain of love (*Antigonon leptopus*): Exploring nutraceutical potential of Guam's invasive vine
Lead Researcher: Sahena Ferdosh, Ph.D. | ferdoshs@triton.uog.edu
Timeframe: June 2024 – January 2025

Covering an estimated 6% of Guam's landmass, the invasive chain-of-love vine contains untapped medicinal potential in its flowers and leaves.

Relevance: Often seen spilling over fences and creating a net over treetops, *Antigonon leptopus* – locally known as the chain of love or *kadena de amor* – is one of Guam's most aggressive invasive plant species. Introduced in 1905 as an ornamental, this flowering vine now covers an estimated 6% of Guam's landmass – more than 8,200 acres – ranking it as the island's fourth worst weed. Its underground tubers make it nearly impossible to fully remove once established.

While its invasiveness poses a serious threat to native ecosystems by smothering trees and blocking sunlight to understory plants, traditional folk medicine across the globe suggests there might be an overlooked opportunity: using the plant to treat a variety of human ailments, including digestive issues, wounds, and colds. But given that the bioactive content of plants can vary significantly with climate and soil, studying the local variant is essential before drawing conclusions from global data.

Response: Dr. Sahena Ferdosh, a natural products researcher with the agInnovation Research Center of the University of Guam Land Grant, saw an opportunity to investigate whether this botanical problem might also be a pharmaceutical resource. Her team embarked on the first Guam literature review of the plant's pharmacological value. Their research began by searching for the local and cultural significance of the plant. They also searched for studies on its flowers, leaves, stems, and roots to see whether they contained phytochemicals commonly linked to claimed medicinal benefits.

In their review, the team investigated different biochemical techniques that had been used to isolate and identify active compounds, laying the groundwork for possible future pharmacological studies specific to the Mariana Islands' environment.

Results: In the team's extensive literature search, they found that *A. leptopus* contains a broad spectrum of beneficial phytochemicals, including polyphenols, flavonoids, alkaloids, terpenoids, glycosides, and tannins. These compounds are known for antioxidant, antibacterial, antidiabetic, anti-inflammatory, and even anticancer activities in other plant species. Early screenings indicate that the plant does not exhibit acute cytotoxic effects, suggesting it could be safe for further development.

This is the first local research exploring the vine's potential as a nutraceutical – a food- or plant-based compound with health benefits beyond basic nutrition. Their work was published in May 2025 in the peer-reviewed journal Applied Sciences.

Next Steps: The next step involves expanding the biochemical analysis of Guam's *A. leptopus* and comparing findings with those reported in other parts of the world. Long term, this work could inform new ways to repurpose one of the island's worst weeds into a valuable resource, offering both ecological mitigation and economic opportunity.

Research Team: Christel Kei Valerio (Research Assistant, UOG)
Funding Source: None

Photo by Christel Valerio

Published

Applied Sciences
May 2025

BIOCHAR USAGE IN CROP SOIL FOUND TO CUT CO^2 EMISSIONS AND BOOST YIELD

Project Title: Commodities and practices to reduce greenhouse gas emissions in Pacific island forestry and agriculture systems (CaPPacForAg)
Lead Researcher: Romina King, Ph.D. | roking@triton.uog.edu
Timeframe: November 2023 – November 2028

The research team is bringing knowledge directly to Guam and Saipan farmers on how to create biochar from green waste and how to apply it as a soil amendment.

Relevance: Guam's nutrient-poor soils severely limit crop yields, threatening local food security and increasing the island's reliance on costly imports. The island also produces a lot of green waste that could be put to productive use.

Biochar – a natural product made through pyrolysis, or the slow burning of biomass, including green waste, in an environment lacking oxygen – has been effective around the world in enhancing soil quality and improving its water retention while capturing carbon that would otherwise be released from the soil into the atmosphere.

Local farmers, who face financial losses from degraded land, would benefit directly from the use of biochar in their soils, while the broader community would benefit from increased food sovereignty and sustainability. As climate change worsens conditions, biochar application offers a timely, scalable approach to climate-smart agriculture across the Pacific.

Response: A research team led by geographer Dr. Romina King of the agInnovation Research Center of the University of Guam Land Grant set out to investigate the production, use, and impact of biochar on island farms. The project, known as CaPPacForAg, is one of 141 projects funded by the U.S. Department of Agriculture to implement climate smart practices.

The team developed Guam's first large-scale biochar kiln, which turns organic matter that would otherwise be green waste into biochar via pyrolysis. They then tested different amounts of biochar on two common soil types in Guam to find an optimal application that would capture the most carbon dioxide and also improve crop yields.

The project has made use of innovative technology, including unmanned aerial vehicles and a portable soil analyzer, the Gasmet GT5000, to measure emissions and assess how biochar affects different types of soil.

Results: The results found that applying 7.5 tons of biochar per acre in northern Guam soils improves crop yield while reducing emissions. Additional tests are underway in southern Guam, where the acidic soils may show even greater benefits.

The research team has engaged directly with farmers in Guam and Saipan, teaching them how to apply biochar and how to build a small-scale kiln to produce their own biochar. The kiln at UOG's agricultural experiment station, capable of producing 2,000 pounds of biochar, will also continue to supply biochar to local farmers.

In testing biochar on island and teaching local farmers how to use it, the CAPPacForAg project has begun an important effort to reduce the vulnerability of farms in Pacific island communities. The use of biochar in agriculture has the potential to improve poor soil conditions and crop yields in a sustainable and eco-friendly manner while also increasing the islands' resilience against abrupt environmental changes.

Main: (From left) Ferdinand Galsim, Dr. Mohammad Golabi, and Daniel Encio add green waste to a biochar kiln on the Yigo experiment station.

Inset: Dr. Mohammad Golabi introduces Saipan farmers to biochar during an outreach event in November 2024.

Photos by Ronald Fuellas/USDA Pacific Climate Smart Commodities

Next Steps: By 2028, the project aims to expand its collaborations to 22 farms across Guam and the Northern Mariana Islands. During this time, the team will also begin analyzing the long-term effects of biochar usage and conducting a cost-benefit analysis. Their findings will then be submitted for publication to academic journals and presented at regional and national conferences to guide farmers, policymakers, and researchers.

Research Team:	Mohammad Golabi, Ph.D. Kuan-Ju Chen, Ph.D. Roseann Jones, Ph.D. Dr. Ting Chi, Ph.D. (Washington State University)
Research Associates:	Annisa Lujan, Daniel Encio, Ferdinand Galsim, Mira Mariur, Andrea Velasquez, Ronald Fuellas
Funding Source:	U.S. Department of Agriculture (Grant No. NR243A750004G018)

NASA-FUNDED PROGRAM INSPIRES GUAM YOUTH TO EXPLORE STEM CAREERS

Project Title: NASA Guam Space Grant STEM Saturday Program
Lead Researcher: Romina King, Ph.D. | roking@triton.uog.edu
Timeframe: January 2024 – Present

In the first year of the STEM Saturday program, more than 100 students participated in hands-on STEM workshops related to real issues in Guam.

Relevance: Despite the integral role that science, technology, engineering, and mathematics (STEM) play in solving community challenges, Pacific islanders are among the least recognized groups pursuing careers in STEM (Kerr et al., 2018). A 2015 study by Victor Levine of the East-West Center cites inadequate funding, a gap in technical capacity, and a lack of opportunities as key barriers. With its many unique challenges, ranging from environmental issues to health care and infrastructure, the Micronesian region could greatly benefit from increased local talent in STEM-related careers.

Students, teachers, and the local workforce are all affected by the lack of STEM engagement among youth on island. Without dedicated programs to enable students to discover an interest or aptitude for these fields, Guam risks falling short of developing a technically skilled workforce capable of advancing locally driven solutions.

Response: Under the leadership of Dr. Romina King, the NASA Guam Space Grant program of the UOG agInnovation Research Center launched its STEM Saturday program to offer K–12 students structured, hands-on, and free STEM learning experiences once per month. The curriculum was developed to align with NASA's Science Mission Directorate goals and aims to inspire long-term interest in science, technology, engineering, and math. Curriculum was designed to integrate the hands-on use of various technologies, like drones and coding software. The lesson plans have also been designed to be easily replicated in school settings.

The program collaborates with village mayor's offices and other community venues to reach a wide range of youth. Guest speakers are also invited to bring local subject matter expertise – coming from programs such as the Guam Coral Reef Initiative, Bella Wings Aviation, and the Pacific Islands Climate Adaptation Science Center (PI-CASC).

Results: The program has offered 10 workshops so far, covering more than 20 unique activities, ranging from spacecraft engineering and space exploration to drone mapping and coral reef science. The topics have each been tied to real-world, local applications – many directly related to environmental concerns happening in Guam.

In its first year, the program has reached more than 100 students and involved numerous University of Guam student volunteers. Feedback from students, teachers, and parents has been overwhelmingly positive, with many students indicating a newfound interest in STEM fields and future careers. Educators and community leaders have recognized the program's impact and have requested expanded offerings in 2025.

The program has also set a precedent as a free education initiative on a community-wide scale that could create a model for similar educational programs seeking to reach underserved communities.

Next Steps: By establishing a sustainable, community-based model for STEM engagement, STEM Saturday could serve as a regional template for similar programs across Micronesia. In 2025, the team plans to introduce new modules, such as "Exciting Engineering," extend outreach to more remote communities, and train UOG students as "STEMbassadors" to help scale the initiative. Findings are being shared through outreach reports and education conferences to inform and inspire future programs.

Children participate in an earth science experiment, exploring how melting land-based ice can contribute to sea level rise during an "Exploring Our Earth" module for STEM Saturday. *Photo by Keanno Fausto*

Project Team: Danielle Hagen
Keanno Fausto
Funding Source: National Aeronautics & Space Administration (NASA Guam Space Grant)

DRONE CORAL REEF MAPPING PROJECT PROVIDES BASELINE DATA AMID GLOBAL BLEACHING EVENTS

Project Title: UOG Drone Corps coral reef mapping campaign in Micronesia
Lead Researchers:
Dr. Romina King, Ph.D. | roking@triton.uog.edu
Dr. Leslie Aquino, Ph.D. | aquinoL8112@triton.uog.edu
Timeframe: May 2024 – December 2024

High-resolution reef maps of 13 key sites in Guam and Saipan have been generated by the UOG Drone Corps to more effectively monitor and respond to coral bleaching.

Relevance: In April 2024, the National Oceanic & Atmospheric Administration confirmed Earth's fourth mass coral bleaching event on record, signaling severe stress on coral ecosystems due to rising ocean temperatures. For island regions like Micronesia, where coral reefs are vital to biodiversity, fisheries, coastal protection, and tourism, the stakes are high. The last major bleaching event in Micronesia occurred in 2017, and the need for early, accurate data to guide conservation strategies has never been greater.

Response: Recognizing this urgency, the University of Guam Drone Corps under UOG Land Grant's agInnovation Research Center launched a coral reef mapping campaign to produce high-resolution imagery and establish critical pre-bleaching baseline datasets. The team worked with local agencies, including the Guam Coral Reef Initiative and Northern Mariana Islands Division of Coastal Resources Management, to identify priority sites. Then, in partnership with NASA Guam Space Grant, NASA Guam Established Program to Stimulate Competitive Research (EPSCoR), and the Pacific Islands Climate Adaptation Science Center (PI-CASC), the project deployed unmanned aerial vehicles (UAVs) to map coral reefs in Guam and Saipan from June to November 2024.

The project involved advanced drone technologies, including NASA's fluid lensing and RGB sensors. Drone flights were programmed to follow precise paths, capturing thousands of images during low-tide conditions to reduce distortion and improve visibility. These were processed into georeferenced orthomosaic maps using software like DroneDeploy and ArcGIS.

Results: The project produced detailed orthomosaic coral reef maps and thousands of high-resolution aerial images of 13 coral reef sites (available at https://www.uog.edu/wptrc/magic), including for priority areas like Tumon Bay and Piti Bomb Holes in Guam and Bird Island, Lao Lao Bay, and Pau Pau Beach in Saipan. The maps provide baseline pre-bleaching datasets for making long-term comparisons. These outputs are now being used by natural resource managers to inform coral reef management plans, restoration efforts, and climate adaptation strategies.

This initiative is one of the largest drone-based coral reef mapping efforts in the region. It sets a new standard for efficient, non-invasive monitoring of reef health. The campaign also enhances Guam's research capacity and workforce development, expanding interdisciplinary collaboration among environmental and geospatial scientists. The UOG Drone Corps program, which launched in 2021, has trained and licensed 42 students to become Federal Aviation Administration Part 107 commercial remote pilots.

Next Steps: Looking forward, the UOG Drone Corps plans to expand its mapping efforts to the Northern Mariana Island of Rota and the Federated States of Micronesia. Additional campaigns will continue to build baseline datasets and contribute to long-term monitoring programs across the region. The project's findings and products will be shared with regional partners and used to shape future conservation research.

Research Team: Jonelle Sayama, Andrea Velasquez, Kaya Taitano, Frank Lujan, John Borja, Keanno Fausto, Annisa Lujan

Funding Source: National Aeronautics & Space Administration (NASA Guam Space Grant and NASA Guam EPSCoR)
U.S. Geological Survey (Pacific Islands Climate Adaptation Science Center)

Jonelle Sayama and Andrea Velasquez of the UOG Drone Corps observe a drone during a coral mapping mission in Saipan in November 2024.
Photo by Keanno Fausto

GENETIC INSIGHTS SET STAGE FOR STRONGER, SMARTER HOT PEPPER FARMING IN GUAM

Project Title: Identify genetic variability of local open-pollinating hot pepper accessions in Guam
Lead Researcher: Mari Marutani, Ph.D. | marutanim@triton.uog.edu
Timeframe: 2023 – 2024

Relevance: In Guam, hot peppers – locally known as *donne'* – are more than just a favorite food. They're a cultural icon and a vital crop for small farmers and local value-added food businesses. But despite their popularity, little is known about the origins of the many pepper types grown across the island.

A key challenge for growers is the lack of verified planting material. Without knowing the species or genetic traits of their peppers, farmers face uncertainty in seed quality, pest resistance, and crop performance. This limits yield and product consistency – especially for small businesses that rely on peppers as a signature ingredient.

Response: A research team led by horticulturalist Dr. Mari Marutani of the University of Guam Land Grant agInnovation Research Center analyzed 37 pepper samples, which were collected from farms and wild areas on Guam and Tinian, using MIG-seq, a powerful DNA sequencing tool that provides detailed genetic data.

This research aimed to provide scientific insight into the genetics of local peppers so that growers can make more informed decisions about what to plant and how to improve their crops.

Knowing the genetic identity of local peppers can help:

- Improve seed quality and crop reliability
- Support breeding of better-performing varieties
- Preserve culturally significant wild types
- Strengthen marketing and branding for local food products
- Boost food security through a stronger seed system.

> Despite their cultural and economic importance, many of Guam's local hot peppers had never been genetically identified until now.

Results: In partnership with Dr. Koji Takayama of Kyoto University, the team identified three distinct species groups:

- **C. frutescens (20 accessions)**
  Included in this species are 'Dragon' and 'Guåfi'
- **C. annuum (15 accessions)**
  Included in this species are 'Hachon' and 'Mañu'
- **C. chinense (2 accessions)**
  Included in this species are commercial cultivars 'Chocolate Habanero' and 'Ghost Pepper'

The results were shared by UOG undergraduate student Alexander Greene at UOG's 2024 Conference on Island Sustainability to help increase public awareness. The study has also been published in the April 2025 edition of the peer-reviewed journal HortScience.

By revealing the genetics behind hot peppers in Guam, farmers and businesses gain a new tool to grow, market, and sustain a vital part of Guam's agricultural future.

Research Team: Dr. Koji Takayama (Kyoto University)
Michael Fernandez
Alexander Greene
Chieriel Desamito
Funding Source: National Institute of Food & Agriculture, U.S. Department of Agriculture (Accession No. 7004065)

Published

HortScience
April 2025

EXTENSION

ABOUT THE UOG EXTENSION SERVICE

The **UOG Extension Service** of the University of Guam Land Grant works directly with Guam residents, delivering practical, research-based information and informal education. Our priority focus areas include:

- agriculture
- food and nutrition
- natural resources
- family and consumer sciences
- youth development

UOG Extension offers community-level workshops, trainings, demonstrations, and educational materials as well as one-on-one support and technical support.

UOG Extension is one of 112 extension units nationwide that make up the national Cooperative Extension System. Extension work is funded both through the local government and the National Institute of Food & Agriculture of the U.S. Department of Agriculture.

SHEET MULCH FOR HOT PEPPERS IN GUAM: A LOW-COST METHOD TO IMPROVE YIELD AND REDUCE LABOR

Project Title: Case study: Evaluation of the effects of mulch on operation costs and yield of hot pepper
Project Team:
Mark Acosta, B.S. (Technical Advisor) | macosta@triton.uog.edu
Glenn Takai (Farmer)
Joseph Tuquero, M.S. | tuqueroj@triton.uog.edu
Timeframe: September 2021 – February 2022
Funding Source: Western SARE (Grant No. FW19-348)

Relevance: Hot peppers (*donne'*) are a staple in Guam's cuisine and economy, particularly valued in local dishes and condiments like *fina'denne' dinanche*. Demand remains high throughout the year, with fresh peppers selling for an average of $12 per pound and processed products, like local hot sauces, priced around $1.25 per ounce. Beyond their culinary value, hot peppers offer notable health benefits as rich sources of vitamins A and C.

However, for local farmers, the crop presents operational challenges. Weed control is particularly labor-intensive in Guam's humid tropical environment. Weeding also increases soil erosion and moisture loss. As producers seek methods that reduce labor and increase profit margins, sheet mulching emerges as a promising, low-cost conservation technique.

Response: To evaluate the effectiveness of sheet mulching in commercial hot pepper production, two UOG Extension agents collaborated with a local farmer to conduct an experiment on his farm in the village of Talo'fo'fo'. A local hot pepper variety known as *Guåfi* was grown under two treatments: with and without mulch.

Sheet mulching is a layered method of mulching. Typical sheet mulching methods consist of initially laying single or multiple layers of cardboard over a targeted area. Cardboard layers can be topped with shredded/chipped organic waste material. It is a simple, low-maintenance conservation practice used for weed suppression, erosion control, and reducing soil moisture loss. It also works as a soil amendment (organic matter) that maintains and improves soil quality and quantity as mulch materials decompose.

> Hot pepper plants grown with sheet mulch produce significantly higher yields and require 75% less weeding labor compared to unmulched plants.

The experiment involved applying 3 inches of layered sheet mulch containing cardboard, grass clippings, and shredded paper around the base of each plant. A total of 54 plants (27 mulched, 27 unmulched) were monitored for yield and operational cost differences.

Two weeding intervals – at 2.5 weeks and one month – were tested. Labor and fuel costs were calculated based on Guam's minimum wage ($9.25/hr) and average fuel prices (~$5/gallon).

Results: The mulched plants outperformed unmulched plants in both yield and labor efficiency. Yield data, collected weekly, showed a significant increase in pepper output from mulched plots. Labor time for weeding was also drastically lower in mulched plots, requiring one-quarter of the labor time compared to unmulched plots.

While the total operational costs for routine weeding were similar across treatments, the reduction in time and intensity of labor offers a significant benefit to growers. Most mulch materials were acquired at no cost, with minimal expense related only to fuel and labor for application.

(Above) Rows of hot pepper plants on Glenn Takai's farm with sheet mulch applied.
(Right) Guam farmer Glenn Takai, right, with his hot pepper harvest.

Next Steps: This case study highlights sheet mulching as a viable strategy to reduce labor, suppress weeds, and boost yields in Guam's hot pepper production, in particular small-scale production. The results support wider adoption of sheet mulching in tropical agroforestry systems.

Future research will explore long-term impacts on soil health, nutrient retention, and water use efficiency. Additionally, workshops and field demonstrations may help expand adoption among small-scale growers across the region.

GRAFTING GAINS GROUND: UOG SPURS IMPROVED MANGO PRODUCTION IN GUAM

Project Title: Impact of UOG Extension efforts to promote grafting of fruit trees
Project Lead:
Robert F. Bevacqua, Ph.D. | bevacquar@triton.uog.edu
Timeframe: January 2021 to Present

Grafting workshops at UOG have led to 6 individuals now actively grafting mango trees, two nurseries offering grafted mango trees, and more than 100 grafted mango trees planted in Guam.

Relevance: Guam faces a consistent demand for local fruits, with mango being one of the most popular. Even though farmers are eager to satisfy this demand, it is still more common to find imported rather than locally grown mangos in stores. This is due, in part, to limited access to quality plant varieties and propagation methods that do not ensure favorable fruit qualities.

A common way of propagating mango trees among Guam residents is by planting the seed of a mango that had desirable qualities. However, mango trees grown from seed will not necessarily produce the same variety of fruit as the mother tree. Grafting, or surgically combining two trees to produce a superior plant, is an alternative propagation method that ensures quicker fruit production, more desirable and consistent fruit qualities, larger fruit, more compact trees, and stronger root systems.

With more grafted mango trees on island, farmers and gardeners could ensure their trees bear mango varieties popular with consumers, thereby increasing demand for local mango, improving the island's economy, and helping to make Guam more self-sufficient in food production.

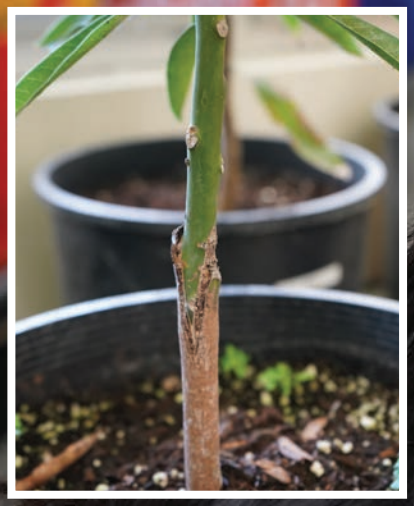
Response: Addressing this, UOG Land Grant launched a two-pronged effort: 1) make improved mango and avocado varieties available to growers and 2) encourage and educate growers to adopt grafting as the preferred propagation technique.

The seeds for this effort were planted 30 years ago, when UOG imported numerous varieties of mango and avocado from southern Florida and established them on UOG's experiment stations. The young trees represented the most important commercial and backyard varieties in the world. In recent years there has been an intense effort to develop these trees as sources of scions or budwood for grafting, with agriculture students volunteering nearly 1,000 hours of labor to revitalize the orchards as a source of germplasm for propagation.

In 2021 to 2025, UOG Land Grant Extension Service held six grafting instruction workshops for the public using scions from its orchard. The workshops averaged 25 participants each, resulting in about 150 growers who now have the knowledge and skills to improve the quality of their mangos. The technique was also taught and practiced in various agriculture classes at UOG.

Results: This effort is already yielding measurable results. Two commercial nurseries now offer grafted mango trees using varieties from UOG's orchard. Six local hobbyists are actively grafting their own mango trees with scion wood from UOG's orchard. And most notably, 100 individuals who completed the grafting workshops have successfully planted grafted mango trees on their farms or in their home gardens.

These outcomes signal a shift toward a more modern and successful approach to fruit cultivation in Guam. As growers adopt grafting, they will improve their ability to consistently grow high-quality fruit, which supports Guam's broader goals of food security and economic



UOG agriculture student Cecilia Pangelinan uses a knife to splice a mango rootstock for grafting with the scion of another mango tree variety. *Photo by Jackie Hanson*

resilience. Consumers also benefit – with increased access to locally grown fruit that is fresher and more nutritious.

The combined approach of education, making quality propagative material available, and engagement with local nurseries has also created a replicable model for other high-value crops, like avocado.

Next Steps: Next steps could include expanding grafting training to other regions of Micronesia, offering grafting workshops for other types of trees, such as avocado, and further engaging nurseries to boost supply.

Project Partners: Anthony Yatar, Chris Leon Guerrero, Glenn Dulla, Ph.D., Autumn Yatar, Aidan Yatar

Funding Source: Beginning Farmer & Rancher Development Program, U.S. Department of Agriculture

BOOTS ON THE FARM:
UOG LAND GRANT ASSISTS WITH CENSUS OF AGRICULTURE FOR GUAM

Project Title: 2023 Census of Agriculture for Guam
Project Lead: Peter Barcinas, M.S. | pbarcina@triton.uog.edu
Timeframe: February 2024 – August 2024

UOG Land Grant assisted USDA in compiling the most comprehensive farm listing to date, conducting on-site surveys, and operating a call center.

Relevance: The Census of Agriculture is a critical tool in understanding and supporting the agriculture industry in every state and territory. Conducted every five years, the census provides the only comprehensive and impartial agricultural data for Guam. The latest census was particularly timely as local farmers face the dual pressures of climate change and an increasing public interest in island food security.

With agriculture in Guam often overshadowed by other sectors, having updated statistics – like the total $6.1 million in sales and the rise in number of farms from 264 to 583 since 2018 – makes a strong case for increased investment and support. Local and federal agencies, industry organizations, policymakers, and agribusinesses and farmers themselves rely on this data. It is used to guide decisions on disaster relief eligibility and farmer support programs and provides reference points for agricultural research and policies.

Response: To carry out the 2023 Census of Agriculture, USDA's National Agricultural Statistics Service partnered with the Guam Department of Agriculture and the UOG Land Grant Extension Service, which partners with agencies and organizations on data collection efforts in the public interest. From February to August 2024, they surveyed more than 500 farmers across the island.

UOG Land Grant assisted USDA in compiling and validating the most thorough farm listing utilized in Guam's agricultural census to date and in overseeing the fieldwork effort for the census by operating a call center and administering survey incentives.

Results: The census recorded 583 active farms on Guam – a 120% increase from 2018 – with 2,848 acres in production and $6.2 million in total sales. Vegetables and melons led in sales, generating more than $2.6 million. These figures underscore both growth and opportunity in Guam's farming sector.

Released in April 2025, the survey's data will be used for long-term monitoring of Guam's agricultural industry, policymaking, and farmer support. The collaborative effort also initiated the development of a joint farm registry among the Guam Department of Agriculture, UOG Land Grant, and the Mayors' Council, which will better amplify the visibility and voices of local producers.

The 2023 Guam Census of Agriculture was released in April 2025 and can be viewed at https://www.nass.usda.gov/Publications/AgCensus/2022/index.php.

Project Team: Benjamin Raetilmwai
JThomas Tyquiengco
Funding Source: National Agricultural Statistics Service, U.S. Department of Agriculture

Photo by Mia Alvarez


Guam Census
of Agriculture
Access Here
CENSUS OF
AGRICULTURE
OFFICIAL

FARMER FOCUS DELIVERS REGIONAL FIRSTS FOR MENTAL HEALTH IN AGRICULTURE

Project Title: Redefining agriculture in the Western Pacific region through diversifying resources and fostering sustainable partnerships
Project Leads:
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Tim de La Cruz, Ph.D. | delacruzt237@triton.uog.edu
Project Timeframe: January 2024 – December 2024

In 2024, the Farmer Focus project brought a first-time conference on farmer mental health and well-being to the Micronesian island of Yap, a first-time AgrAbility conference to Guam, and certified 59 professionals in Mental Health First Aid.

Relevance: Stress surveys conducted between 2022 and 2023 across Guam, the Federated States of Micronesia, and the Northern Mariana Islands found that 65% of agricultural producers and 77% of farm workers report medium to high levels of stress. Contributing factors include financial instability, labor shortages, climate-related pressures, and long hours. These challenges are compounded by limited access to behavioral health services. Moreover, the agricultural sector nationwide experiences higher suicide rates compared to other sectors.

Recognizing the importance of farmer well-being to food security and community health, University of Guam Land Grant and its partners through the Farmer Focus program have continued to carry out region-specific programs to address both the immediate and long-term mental health needs of farmers and those who can benefit from farming-related activities, including youth.

Response: Under the leadership of agricultural economist Dr. Kuan-Ju Chen and human services specialist Dr. Tim de la Cruz, UOG Land Grant launched the Farmer Focus project in 2022 to address the mental health challenges faced by agricultural communities.

In 2024, Farmer Focus expanded its reach with several regional firsts. The third regional Farmer Focus Conference took place on the Micronesian island of Yap, with 70 participants exploring topics such as stress management, agroforestry practices, and local resources. In October, the first-ever Guam AgrAbility Workshop, co-hosted with the National AgrAbility Project, convened 185 farmers, ranchers, and agriculture-related professionals to explore assistive tools, low-tech equipment modifications, and mental health services for individuals facing physical or cognitive limitations.

To build on these efforts, 45 individuals who work closely with farmers received certification in Mental Health First Aid in Yap and Guam. The initiative also included a youth component. Gardening workshops for more than 40 public school students highlighted the behavioral health benefits of plant care and environmental engagement.

In addition, the program partnered with National Taipei University's School of Nursing to deliver health screenings for farmers and ranchers.

Results: In 2024, Farmer Focus engaged more than 200 individuals across conferences, workshops, screenings, and educational activities. The certification of 45 individuals in Mental Health First Aid significantly increased community capacity to recognize and respond to mental health challenges.

The number of event participants and new partnerships formed is evidence of a growing network of support for agriculture workers and their families that has not existed before. This project is the first of its kind in the Micronesian region to focus on agricultural worker stress and mental health. The first-time events held in 2024 have set a precedent for similar future programs in the region.

Main: Visiting agricultural professionals and researchers tour a farm during a field trip of the 2024 Farmer Focus Conference in Yap.

Inset: UOG extension associate Mary Catherine Wiley shares stress management resources with farmers at the 2023 Farmer Focus Conference in Pohnpei.
Photos by Mia Alvarez

Next Steps: In 2025, the project aims to host two more regional Farmer Focus Conferences, one in Palau and another in Guam, and further strengthen partnerships with Taiwanese universities. Plans also include presenting outcomes nationally, including at the AgrAbility National Training Workshop in New Mexico, and integrating programming into routine care through local providers.

Project Team: Rita Sharma, Ph.D. (University of Guam)
KristiAnna Whitman, Ph.D. (Guam Behavioral Health & Wellness Center)
Project Assistants: Kaelan Arciaga, Fang-Chu Kuo, Fang-Ning Kuo, Long Yip
Funding Source: Farm & Ranch Stress Assistance Network, U.S. Department of Agriculture (Grant No. 2023-70028-41285)

TYPE 2 DIABETES PREVENTION PROGRAM IN GUAM SHOWS PROMISING RESULTS

Project Title: Increasing health literacy: Prevent T2
Project Lead:
Shelly Blas Laguaña, Ph.D. | mlaguana@triton.uog.edu
Timeframe: October 2022 – September 2025

33% of Prevent T2 participants lost 5% of their body weight, and another 33% combined weight loss with 150 minutes of weekly physical activity.

Relevance: The Western Pacific region, including Guam, holds the dubious distinction of having the highest prevalence of diabetes and prediabetes among adults aged 20–79 globally, as reported by the International Diabetes Federation in 2019. A study by Chan et al. (2013) revealed that 50% of individuals with diabetes in Guam expressed interest in preventive services. However, with only one CDC-recognized diabetes prevention program available through an insurance provider, the region faces a critical gap in accessible preventive care.

The issue affects not only those living with prediabetes, but also the broader community, burdened by the increasing prevalence of diabetes and the associated long-term health costs. The Prevent T2 program, aimed at addressing these health challenges, offers a proactive approach to help individuals reduce their risk of developing type 2 diabetes.

Response: In an effort to reduce the incidence of type 2 diabetes in Guam by promoting sustainable lifestyle changes, UOG Land Grant, under its health and wellness initiative, brought the Prevent T2 program to Guam. The program is part of the CDC's National Diabetes Prevention Program and educates individuals at risk of progressing from prediabetes to type 2 diabetes on evidence-based interventions that target modifiable risk factors, such as diet, weight, and physical activity.

The pilot program engaged interested participants who qualified based on their scores on the CDC's Prediabetes Risk Test. The comprehensive year-long program paired participants with dedicated lifestyle coaches and a support group of individuals with similar challenges and goals. They attended 22 intensive sessions covering goal setting, weight management, heart health, stress management, and how to live an active lifestyle, among other topics. They met weekly during the first six months, followed by monthly check-ins for the remainder of the year.

Results: The pilot project demonstrated promising health outcomes among participants with prediabetes:

- 33% of participants achieved 5% weight loss.
- Another 33% combined weight reduction with maintaining 150 minutes of exercise weekly.
- Two participants lost nearly 4% of their body weight within the first six months, with one tracking toward 5% weight loss.

On average, participants engaged with 16 intervention modules, with some continuing their participation beyond the program's formal end. These results underscore the program's potential to support long-term health improvement for those at risk of type 2 diabetes through supportive education on weight management, increased physical activity, and healthy eating.

The program addresses an urgent public health issue in Guam and could serve as a model for other islands in Micronesia facing similar challenges with diabetes.

UOG Extension Associate Elaine de Leon explains the Prediabetes Risk Test to a Guam resident.
Photo by Jackie Hanson

Next Steps: The Prevent T2 program will continue expanding, with plans to reach more participants and further refine its approach in the coming year. Long-term monitoring of participant health outcomes will provide additional data to assess the program's effectiveness in reducing the risk of type 2 diabetes. Future efforts will include exploring partnerships to integrate the program with routine patient care at local health care providers. The project team will also present the program's results at public health forums to raise awareness of diabetes prevention strategies.

Project Team: Elaine de Leon, M.S.
Iesha Ibanez
Funding Source: Extension Capacity Fund (Smith-Lever 3(b) and 3(c))

FOOD PROCESSING WORKSHOPS INSPIRE RESIDENTS ON NEW USES FOR TURMERIC

Project Title: Enhancing community awareness of turmeric's benefits and products in Guam
Project Lead: Jian Yang, Ph.D. | jyang@triton.uog.edu
Timeframe: January 2024 – December 2024

Relevance: Turmeric, a tropical plant that thrives on Guam, has been used for more than 4,000 years in Asian cuisine and traditional medicine. Despite its wide-ranging health benefits – including anti-inflammatory, antioxidant, anticancer, and anti-diabetic effects – many local residents remain unaware of its full potential. Turmeric is often grown in backyards, yet its use is limited primarily to the kitchen, and its health benefits are not widely recognized.

Given the growing interest in natural remedies and locally sourced products, there is a greater need to educate the community about turmeric's health benefits and its versatility in value-added products. Gardeners and community members who can purchase locally grown turmeric would benefit from knowing some additional ways to use the plant for both health purposes and culinary use. Farmers who grow and sell turmeric could also benefit from this information to enhance their marketing and build stronger consumer demand for a crop that grows well in Guam's climate. Knowledge of its uses may also inspire farmers to produce and sell value-added products in addition to the fresh product.

Response: The food science team at the UOG Land Grant Extension Service, led by Dr. Jian Yang, organized two hands-on workshops focused on teaching residents how to process turmeric into different value-added products. The team tested and refined recipes for turmeric powder, turmeric-ginger candy, turmeric mochi, and golden turmeric coconut milk to be the featured products for demonstration.

Workshops taught residents more uses for their backyard-grown turmeric, including products like turmeric-ginger candy and mochi.

Registration filled quickly, with the maximum capacity of 22 participants coming to each session. The workshops were designed to educate local residents about turmeric's health benefits and cultivation methods as well as offer them easy, accessible ways to use the crop.

Additionally, turmeric candies were prepared as samples at the University of Guam's Charter Day event, further raising awareness among residents, students, and consumers about turmeric's versatility and potential. Recipe cards were also created for each product and posted on the UOG Land Grant website.

Recipes

Results: The workshops and food demonstrations had a significant impact on the participants:

- Participants personally experienced making turmeric powder, turmeric-ginger candies, turmeric mochi, and golden turmeric coconut milk. The hands-on aspect increases the likelihood they will try it again and share their new knowledge with friends and family.
- Many attendees were surprised by how easy it was to create high-quality, value-added turmeric products in a home kitchen.
- Feedback was overwhelmingly positive. Participants expressed satisfaction with the products' flavor, appearance, and quality.
- Participants were inspired to try growing turmeric at home.

Guam residents make ginger-turmeric candies during a value-added food products workshop on turmeric held by UOG Extension in September 2024. *Photo by Conrad Calma*

An upcoming extension publication will feature instructions and recipes for turmeric-based products and will further guide residents in incorporating turmeric into their daily routines.

Next Steps: High demand to attend the workshops has shown a need to offer more turmeric processing workshops in the future. The food science team will continue to develop more value-added turmeric products, giving residents and entrepreneurs more opportunities to utilize this abundant resource. These efforts will likely encourage more local production of turmeric, fostering a thriving market for turmeric-based products in Guam.

Project Team: Clarissa Barcinas
Elaine De Leon, M.S.

Funding Source: Smith-Lever, U.S. Department of Agriculture
NIFA Value-Added Food Products,
U.S. Department of Agriculture

FAMILY RESILIENCY WORKSHOPS EQUIP GUAM RESIDENTS YOUNG AND OLD FOR LIFE'S CHALLENGES

Project Title: *Na Fitme I Familia-Ta* (Family Resiliency)
Project Lead: Tim C. de La Cruz, Ph.D. | delacruzt237@triton.uog.edu
Timeframe: FY2024

Relevance: While Guam has a deep-rooted tradition of family caregiving, modern stressors and evolving social dynamics are placing new demands on families and individuals. With Guam facing high rates of age-related illness and widespread financial stress, the need for accessible, community-based education has never been greater.

Residents of all ages can benefit from practical tools to face issues related to aging, family relationships, and financial stability, all of which then provide the security to be able to handle other challenges in life.

The program targets both youth and seniors – groups particularly vulnerable to the consequences of poor planning or unhealthy habits – with the goal of improving quality of life and strengthening intergenerational resilience across the island.

Response: In response, UOG Land Grant's *Na Fitme I Familia-Ta* (Our Family is Strong) Family Resiliency Program, led by Dr. Tim C. de La Cruz, developed various hands-on workshops targeting youth and adults over the past year. A variety of evidence-based curricula were used, including:

- a nine-lesson "Keys to Embracing Aging" series, often paired with nutrition education and healthy cooking demonstrations
- a five-lesson "Walk in My Shoes" curriculum on aging
- a five-lesson youth financial literacy series offered in schools and summer programs
- adult financial literacy sessions covering budgeting, savings, identity theft, and asset protection.

More than 170 youth and adult participants attended hands-on workshops focused on healthy aging, financial literacy, and building life skills, with many reporting positive behavior changes after the program.

The workshops spanned 5-6 sessions and took place in diverse community settings, including a senior center, a residential shelter for individuals with disabilities, public schools, the UOG campus, and nonprofit-led youth camps.

Community partnerships played a key role in the program's reach, including collaborations with Guam Department of Education, Public Health, GALA, Inc., Guma Mami, Inc., and village mayor's offices. Educational kits and personal learning aids were provided to enhance engagement and learning retention.

Results: A total of 169 unique participants attended the Family Resiliency workshops in the past year: 103 in the Keys to Embracing Aging sessions, 48 in youth financial literacy workshops, and 18 in Walk in My Shoes sessions. Participants reported increased understanding of how lifestyle choices affect health, the importance of financial planning, and strategies for aging well.

Highlights from program evaluations include:

- **Keys to Embracing Aging:** In a follow-up survey 30 days following the program, participants recognized that healthier lifestyle choices can promote their independence and lead to a longer life. Most agreed or strongly agreed that they intend to now improve behaviors related to stress management, sleep habits, brain exercises, social interaction, and financial wellness.

Extension Associate Clarissa Barcinas explains a beanbag toss game to a Guam resident during Guam's Huegon Manamko' (Senior Games), an event to promote physical activity and camaraderie among seniors.

- **Teen Financial Literacy:** Participants showed a strong grasp of saving, budgeting, and distinguishing needs from wants, though areas like credit-building and SMART goals showed room for growth.
- **Walk in My Shoes:** Youth participants reported better understanding of aging and expressed an interest in improving self-care habits as well as their communication with elders.

Next Steps: The Family Resiliency team plans to expand workshop offerings in the coming year and refine healthy aging and financial literacy content based on the evaluations. Guam's high rates of non-communicable diseases also underscore the importance of continuing to offer healthy aging events. The program will continue leveraging partnerships to incorporate local expertise and resources into the curriculum.

Project Team: Clarissa Barcinas
Elaine De Leon, M.S.
Harley Edeluchel Jr.

Funding Source: Smith-Lever Act Capacity Grant,
U.S. Department of Agriculture

LOW-INCOME FAMILIES REPORT SAVINGS AND HEALTHIER BEHAVIORS WITH EFNEP

Program Title: Expanded Food & Nutrition Education Program
Program Lead:
Tanisha F. Aflague, Ph.D., RDN | taflague@triton.uog.edu
Timeframe: October 2023 – September 2024

EFNEP participants in Guam in 2024 saved an average of $88 per month on food while improving their diet quality, food safety, and physical activity.

Relevance: Low-income and minority populations in Guam face heightened risks for poor health and chronic diseases. Data from the Center for Disease Control's 2022 Behavioral Risk Factor Surveillance System revealed rising rates in the past three years of diabetes (from 11.7% to 21.6%), heart disease (2.9% to 5.7%), and kidney disease (3.0% to 4.2%) in adults. Meanwhile, fruit and vegetable intake has declined, particularly among income-eligible Supplemental Nutrition Assistance Program (SNAP) households.

Children are similarly affected, with local studies finding that Guam children are not meeting recommended fruit and vegetable intake. A local study has also indicated positive correlations between a child being overweight or obese and having high sugar intake and sleep disturbances. These challenges are further complicated by low health literacy among families earning less than $35K annually and where English is not the primary language.

Response: The Expanded Food & Nutrition Education Program (EFNEP) is an ongoing federal nutrition education program through Land Grant universities. It supports families and youth in making informed, healthy choices that reduce chronic disease risk and stretch food budgets. EFNEP in Guam reaches families where they are – at home, in community centers, and schools – offering hands-on nutrition lessons tailored to local lifestyles.

In 2024, a team of five trained educators delivered programming to 71 parents and 1,125 youth from K-12 across the island. Lessons focus on life skills, such as cooking, budgeting, and smart shopping using modified local recipes and culturally relevant materials, such as posters featuring local produce and smart shopping carts using real market prices. Adult participants spent an average of 14 hours with EFNEP educators.

Results: In 2024, EFNEP achieved a 73% graduation rate among adult participants. Additionally:

- 85% of adults reported a monthly food savings averaging $88.
- 75% or more improved in at least one area related to diet quality, physical activity, or food safety.
- 85% improved their nutrition practices, 53% improved food safety practices, and 23% increased their daily physical activity.
- Youth participants showed measurable improvement in diet quality (54%), food safety (54%), and physical activity (64%).

These results demonstrate that EFNEP effectively addresses not just knowledge gaps, but also behavior changes that lead to long-term health and financial benefits.

Next Steps: EFNEP is adapting to evolving community needs. In the next phase, programming will expand to target emerging adults (ages 19–29), a population segment with increasing nutrition insecurity risk. The team also continues to contribute local data to regional and national impact studies and publications.

Program Team: Rynette Perez, Program Assistant Supervisor
Funding Source: National Institute of Food & Agriculture, U.S. Department of Agriculture (Grant No. NI24EFNEPXXXG074)

85% saved money on food

64% of youth and 23% of adults improved daily physical activity

54% of youth and 85% of adults improved diet

Extension Associate Rynette Perez helps a resident compare the nutrition facts of popular cereals.
Photo by Jackie Hanson

GUAM SNAP-ED PROMOTES HEALTHIER LIVING FOR FOOD-ASSISTANCE POPULATION

Program Title: Supplemental Nutrition Assistance Program – Education (SNAP-Ed)
Program Lead:
Tanisha F. Aflague, Ph.D., RDN | taflague@triton.uog.edu
Timeframe: October 2023 – September 2025

Relevance: Guam continues to face high rates of chronic disease, exacerbated by a vulnerable, import-reliant food system that increases availability of processed foods. Statistics from the Centers for Disease Control & Prevention's Behavioral Risk Factor Surveillance System show that one in three adults in Guam is considered obese, with 50 percent not getting the recommended amount of physical activity and 30 to 40 percent not getting enough fruits and vegetables per day.

Low-income populations face heightened risk for poor health and chronic disease, and nearly 20% of Guam's population receive food assistance through the federal Supplemental Nutrition Assistance Program (SNAP). Food aid is essential to reduce food insecurity. It is even more beneficial when paired with education and reinforcement from policies, systems, and environmental changes to help individuals make both the most economical choices as well as the most nutritious choices with their grocery dollars.

Response: The Supplemental Nutrition Assistance Program – Education (SNAP-Ed) through the University of Guam Land Grant focuses on children and families, but also targets older adults (*manamko'*) and adults without children, complementing the youth and families-focused work of the federal Expanded Food & Nutrition Education Program (EFNEP).

Through direct education and social marketing efforts using evidence-based curricula, Guam SNAP-Ed continued its role in 2024 teaching SNAP-eligible residents how to plan and cook healthy meals, add physical activity to their day, and how to shop for healthy groceries on a budget.

> Guam SNAP-Ed brought culturally tailored nutrition and physical activity education to more than 21,000 residents in 2024.

Delivered by six trained SNAP-Ed professionals, this education took place through in-store cooking demos, guided grocery store tours, school field trips and family engagement events on campus, and interactive educational tools and kits provided to schools and daycares. Program materials are locally tailored, featuring Pacific islanders, traditional foods, and produce imagery that resonates with residents.

Additionally, SNAP-Ed professionals actively engaged in community action coalitions and advisory committees to support healthy policies and remain tethered to community needs.

Results: In 2024, Guam SNAP-Ed collaborated with:

- 12 villages
- 13 grocery stores
- 14 elementary and middle schools
- 9 child care centers
- 5 residential community sites
- more than 46 other community partners.

In all, SNAP-Ed events reached 21,587 island residents, including 208 adults who participated in SNAP-Ed direct education classes and 912 youth who received SNAP-Ed nutrition and physical activity education in their classrooms. The program's "5-2-1-Almost None" social marketing campaign – promoting five servings of fruits and vegetables, less than two hours of screen time, one hour of physical

Extension Associate Katrina Macasaquit teaches the 5-2-1-Almost None curriculum to children at a child care center. *Photo by Jackie Hanson*

Among adult SNAP-Ed participants:

25% increased physical activity

33% improved daily fruit intake

28% improved daily vegetable intake

activity, and almost no sugary beverages daily – added five new community pledge partners in 2024, now totaling 38.

Post-program surveys for the adult education classes have shown an increase in physical activity among 25% of participants, improved daily fruit intake by 33%, and improved vegetable intake by 28%.

SNAP-Ed partnered with the CDC's Racial & Ethnic Approaches to Community Health (REACH) program to sustain the program that creates a direct digital referral system for Community Health Center patients to receive SNAP-Ed. Additionally, SNAP-Ed and REACH have collaborated to identify improvements to Guam Public Law 31-141, the Government of Guam Health Vending Machine Policy.

Next Steps: Guam SNAP-Ed will continue expanding its educational reach in the coming year through cross-sector collaborations, especially within schools, food stores, and senior programs. The program team will also continue to grow its community partnerships and assess and refine the program's marketing tools to ensure they remain culturally relevant for optimal impact.

Program Team: Rynette Perez, Program Assistant Supervisor
Funding Source: Food & Nutrition Service, U.S. Department of Agriculture via Guam Department of Public Health & Social Services

NIHI COOKING SERIES: ADDRESSING FOOD INSECURITY WITH PLACE-BASED CUISINE

Program Title: Eat local for nutrition and food security: *Nihi ta Fanmama'tinas* (Let's Cook)
Program Lead:
Tanisha F. Aflague, Ph.D., RDN | taflague@triton.uog.edu
Timeframe: October 2023 – September 2024

In its first year, Guam's *Nihi ta Fanmama'tinas* (Let's Cook) workshops equipped 126 residents — primarily ages 55 and older — with hands-on skills to prepare healthy meals using locally grown produce.

Relevance: Across the Pacific, the shift away from traditional staples toward imported, processed foods has contributed to food insecurity, increasing risk for obesity and chronic disease. In Guam, where nearly 20% of the population receives food assistance and local farms have dwindled in number, residents face increasing food and fuel costs. Reliance on imports has made healthy eating more difficult and expensive. These challenges highlight the need for place-based nutrition education that supports both individual health and the local food system.

Response: The *Nihi ta Fanmama'tinas* (Let's Cook) series was developed under the larger *Eat Local for Nutrition & Food Security* project to address these needs by promoting healthier eating habits using local foods. Grounded in the 2020–2025 Dietary Guidelines for Americans, the workshops focused on increasing intake of fruits and vegetables, addressing nutrient concerns (e.g., fiber, calcium, vitamin D), and reducing added sugars and sodium.

Ten themed workshops were held from October 2023 to mid-2024, serving 126 participants from youth to seniors, but primarily aged 55 and older. Participants engaged in culturally relevant, hands-on cooking sessions using locally grown ingredients. Recipes and materials were developed by a trained team to reflect Guam's food culture, seasonal availability, and nutrient content.

Results: Workshop topics included "Focus on Fiber," "Reducing Added Sugars," "Nutrient-Dense and Low-Sodium Foods" and "More Calcium, Less Fat," attracting 19 to 60 participants per session. Feedback revealed significant appreciation for the cooking component, with participants reporting increased confidence in preparing healthier meals at home, trying new foods, and expanding their food knowledge. The program supported diet quality improvement, helped stretch food budgets, and encouraged cultural knowledge exchange.

Beyond individual benefits, the broader community gains from increased demand for local produce and more home-cooked meals, contributing to improved food security and economic resilience. With Guam's close-knit social structure, healthy habits modeled by participants are likely to influence families and neighbors, extending the impact of the program.

Next Steps: Building on positive feedback, future workshops will expand to focus on disease prevention and management, with requested topics from participants being diabetes, heart health, and label reading. A future workshop series will also integrate the cooking lessons with education on growing the local produce in the recipes – a topic of high participant interest. The cooking activity – widely praised and enjoyed – will remain central to the program's success.

Project Team: Clarissa Barcinas

Funding Source: National Institute of Food & Agriculture – Nutrition Resource Series

Dr. Tanisha Aflague interacts with a Guam resident in the Let's Cook workshop series with UOG Extension. *Photo by Mia Alvarez*

SUBSISTENCE FARMER TRAINING SUPPORTS HOME-GARDENING REVIVAL IN GUAM

Project Title: Subsistence & Small Acreage Farmer Training
Project Leads:
L. Robert Barber Jr., Ph.D.
Mark Acosta, B.S.
Timeframe: May 2024 – July 2024

Over a series of six workshops, UOG Extension trained 66 new small-scale farmers, helping to boost local food security and resilience.

Relevance: Guam's CHamoru Land Trust Commission (CLTC) has issued more than 1,000 agricultural leases over the years, but a 2007–2012 compliance review revealed that more than 80% of leaseholders were not meeting requirements to plant 50 trees and bring two-thirds of the land into production in three years. Through field assessments and interviews, UOG Extension discovered that many faced major barriers: lack of time, skills, equipment, funds, or water access. Sloped and rocky terrain further limited traditional farming methods.

These challenges stem from broader historical shifts. As Guam transitioned to a wage-based economy after World War II, families became increasingly disconnected from the *låncho* (ranch), once central to CHamoru culture and food production. Recognizing this, the UOG Extension Service shifted its strategy away from mechanized farming toward small-scale, low-input methods that align with local capacities and cultural traditions.

Response: To support this shift, UOG Extension agents developed the Fruit Tree–Vegetable Garden Ring model – which consists of a 12-foot circular plot with a central fruit tree surrounded by vegetables, groundcover crops, and lemongrass borders for weed and pest control. Integrating sheet mulch then conserves moisture, suppresses weeds, and builds soil. These systems are scalable, low-maintenance, and suitable for both rural leaseholders and urban gardeners.

The full CLTC curriculum includes 60 hours of training in soil building, water conservation, drip irrigation, plant propagation, pest control, low-input production methods, including raised beds and container gardening, and optional poultry or aquaculture integration. Emphasis is placed on traditional and regenerative growing practices that enhance food security and land stewardship.

Results: In spring and early summer of 2024, UOG Extension held a six-week Saturday training series at the university and nearby demonstration gardens. Each of the 66 participants received hands-on instruction in key techniques, including:

- Raised beds and container gardens
- Sheet mulching and fruit tree ring system
- Contour planting for sloped land
- Drip irrigation installation
- Propagation from seeds, cuttings, and divisions
- Soil building with compost
- Selection of resilient crops

Each participant took home two plants per session – one annual and one perennial – along with propagation knowledge to expand their own gardens. Nearly 800 food plants were distributed, directly increasing food production across the island. Though originally designed for CLTC leaseholders and staff, the workshops quickly filled with members of the public. Participants were actively engaged and eager to gain experience.

Next Steps: UOG Extension's efforts in agriculture education aim to not only facilitate learning, but reconnect families with their land, culture,

Guam residents lay cardboard and shredded paper in a sheet mulching session of the subsistence farmer training series.
Photo by Jackie Hanson

and food systems. By promoting accessible, sustainable practices, the program empowers a new generation of growers committed to self-reliance and food security.

As interest continues to grow, UOG Extension plans to establish village-based demonstration gardens to meet community demand and support regional resilience.

Project Team: Jesse Bamba, M.S.
Robert Bevacqua, Ph.D.
Roland Quitugua, M.S.
Joseph Tuquero, M.S.

Funding Sources: Renewable Resource Extension Act Grant, U.S. Department of Agriculture
Professional Development Program Grant, Western SARE

EXTENSION ENGAGEMENT IN 2024

FAMILY & CONSUMER SCIENCES WORKSHOPS	
Nihi/Let's Cook: Nutrient-Dense and Low-Sodium Foods	Jan. 10
Nihi/Let's Cook: Nutrient-Dense and Low-Sodium Foods	Feb. 10
Nihi/Let's Cook: Nutrient-Dense and Low-Sodium Foods	Feb. 21
After-School Health & Wellness Camp	Feb. 22
GALA Health & Wellness Camp	March 12
After-School Health & Wellness Camp	March 19
GALA Health & Wellness Camp	March 20
Nihi/Let's Cook: More Calcium, Less Fat	March 20
Nihi/Let's Cook: More Calcium, Less Fat	April 20
After-School Health & Wellness Camp	April 24
Nihi/Let's Cook/Keys to Embracing Aging: Let's Chesa!	June 5
Nihi/Let's Cook/Keys to Embracing Aging: Let's Bake!	June 8
Nihi/Let's Cook/Keys to Embracing Aging: Let's Make Soup & Salad!	June 12
Nihi/Let's Cook/Keys to Embracing Aging: Let's Cook on a Budget!	June 15
Nihi/Let's Cook/Keys to Embracing Aging: Let's Cook Breakfast!	June 19
Nihi/Let's Cook/Keys to Embracing Aging: Let's Cook Local!	June 22
GALA Health & Wellness Camp	July 23
UOG New Student Orientation: Building Healthy Habits	August
Nihi/Let's Cook/Keys to Embracing Aging: Let's Chesa!	Aug. 7
Dragon Fruit Post-Harvest and Value-Added Products	Aug. 9
Nihi/Let's Cook/Keys to Embracing Aging: Let's Bake!	Aug. 10
Nihi/Let's Cook/Keys to Embracing Aging: Let's Make Soup & Salad!	Aug. 14
Nihi/Let's Cook/Keys to Embracing Aging: Let's Cook on a Budget!	Aug. 17
Nihi/Let's Cook/Keys to Embracing Aging: Let's Cook Breakfast!	Aug. 21
Nihi/Let's Cook/Keys to Embracing Aging: Let's Cook Local!	Aug. 24
Financial Literacy and Eating Smart for Upward Bound Students	July 8-19
Value-Added Food Processing: Turmeric	Sept. 14
Value-Added Food Processing: Dragon Fruit	Sept. 28
Introduction to Produce Safety	Oct. 9
Processing Value-Added Products	Oct. 17
Nihi/Let's Cook: Focus on Fiber	Nov. 6
Nihi/Let's Cook: Reducing Added Sugars	Nov. 9
Nihi/Let's Cook: Nutrient-Dense and Low-Sodium Foods	Nov. 13
Nihi/Let's Cook: More Calcium, Less Fat	Nov. 16
Value-Added Food Processing: Turmeric	Dec. 14
Prevent T2 Modules	Year-long
SNAP Ed: Eat Smart, Live Strong Series	Year-long
SNAP-Ed: Plan, Shop, Save, Cook Series	Year-long
SNAP-Ed: Cooking Matters Store Tours	Year-long
SNAP-Ed: Food Smarts for Youth Series	Year-long
EFNEP Lessons (Youth and Adult)	Year-long
SNAP-Ed: Cooking Matters Store Tours	Year-long
SNAP-Ed: Food Smarts for Youth Series	Year-long

2,742+
WORKSHOP & CONFERENCE PARTICIPANTS

560+
4-H EVENT PARTICIPANTS

4-H ON-CAMPUS EVENTS	
Air Force and Navy Schools Spring Event	March 28
4-H Summer Camp: Crime Scene Investigation	May 28-31
4-H Summer Camp: High Flyers Aviation	May 28-31
4-H Summer Camp: Health & Wellness	May 28-31
4-H Summer Camp: Creative Me	May 28-31
4-H Summer Camp: Little Gardeners	June 3-7
4-H Summer Camp: Crazy Experiments	June 3-7
4-H Summer Camp: Bugs & Us	June 3-7
4-H Summer Camp: STEAM	June 3-7
4-H Summer Camp: Ethixquest Philosophy Camp	June 3-7
4-H Summer Camp: Home Economics	June 24-28
4-H Summer Camp: Smart Start	June 24-28
4-H Summer Camp: High School Fisheries	July 1-12
Military Child & Youth Camp	July 8-12
4-H Summer Camp: Junior Fisheries	July 15-Aug. 2

AGRICULTURE WORKSHOPS	
Pesticide Safety in Agriculture for Growers and Trainers	Jan. 17-18
Pesticide Safety Education Program: Core Training	Feb. 19-20
Pesticide Safety Education Program: Core Training	Feb. 26-27
Promising Fruit Trees for Guam	March 9
Farmer-Run Agriculture Production Monitoring Training	March 26
Farmer-Run Agriculture Production Monitoring Training	April 17
New Farmer Training for Small Acreages: Sheet Mulching	May 25
Avocado Production	June 1
New Farmer Training for Small Acreages: Plant Propagation	June 8
New Farmer Training for Small Acreages: Soil	June 15
New Farmer Training for Small Acreages: Container Production and Composting	July 6
New Farmer Training for Small Acreages: Slope Farming, Homemade Pesticides, Government Programs	July 13
New Farmer Training for Small Acreages: Drip Irrigation, Raised Bed Gardening	July 20
Farmer Focus Youth Horticulture Workshop	July 11
Farmer Focus Conference: Yap	July 23-25
Companion Animal Welfare Workshop	July 23
Companion Animal Welfare Workshop	July 24
Companion Animal Welfare Workshop	July 25
Farmer Focus Health Checkup	Aug. 13
Farmer Focus Health Checkup	Aug. 15
Farmer Focus Health Checkup	Aug. 17
Farmer Focus Health Checkup	Aug. 20
BBQ Bootcamp: Boston Butt	Aug. 23
Farmer Focus Health Seminar	Aug. 22
Farmer Focus Health Seminar	Aug. 24
Expert Panel on Poultry & Livestock Production	Aug. 24
Strategies for Sustainable Agriculture Seminar	Aug. 24
Guam AgrAbility Regional Conference	Oct. 29-30
Practical Integrated Crop Management for Hemp	Nov. 1

2,258+
FIELD TRIP VISITORS

SCHOOL FIELD TRIPS	Number	Participants
Triton Farm Field Trips	60	1,850
Head Start Field Trips	6	98 youth/ 94 adults
CNAS Aquapark	13	195
STEM Day with SIFA Charter School	1	175
	80	**2,258**

(From left) Frank A. Camacho, interim associate director of research; Maika Vuki, interim associate dean, College of Natural & Applied Sciences; Rachael T. Leon Guerrero, CNAS dean and Land Grant director; L. Robert Barber Jr., interm associate director of extension. *Photo by Jackie Hanson*

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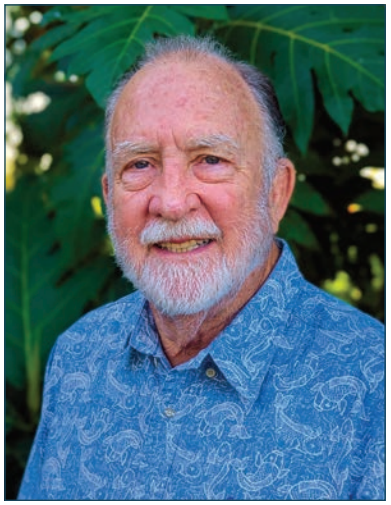
**Dual research/extension faculty*
†Retired

NEW FACULTY



Robert F. Bevacqua, Ph.D.
Extension Agent III/
Assistant Professor of Horticulture

Dr. Robert Bevacqua returned to UOG in 2024 as an extension horticulturalist. He had previously been with UOG as an extension agent in agriculture from 1979 to 1984. In total, he has 20 years of experience in agricultural extension, where he has provided educational programs to farmers who produce fruit and vegetable crops. His current interests center on developing sustainable techniques for the production of banana, watermelon, and papaya as well as the use of grafting for the propagation of mango and avocado trees.

Bevacqua holds a doctorate in horticulture from Oregon State University as well as a master's in horticulture and a bachelor's in anthropology from the University of Hawaii.

Clifford J. Kyota, MPA
Extension Agent II/Instructor of
4-H and Youth Development

Having worked with the 4-H Program under UOG Extension for the past 12 years, Cliff Kyota now moves into a faculty role. He will be working to lead and expand prevention-based programming, on topics such as life skills, civic engagement, and workforce readiness, with a specific emphasis on at-risk youth populations in Guam. He will also research youth risk and resilience factors, culturally responsive approaches, and the effectiveness of experiential learning models.

Kyota holds a B.S. in criminal justice and an MPA from UOG as well as certifications in positive youth development, experiential learning facilitation, and volunteer risk management.

NEW FACULTY

Roland Quitugua, M.S.
Extension Agent II/
Instructor of Horticulture

Having worked in extension with the University of Guam for the past 20 years, Roland Quitugua now moves into a faculty position as an extension horticulturalist. His areas of focus include pest management, food production, arboriculture, and natural resource management. On the research side, he will be working on variety trials for crops and tree care management methods for production and storm resilience.

Quitugua holds a master's in plant pathology from the University of Hawai'i at Manoa and a bachelor's in agricultural crop production from UOG. He is also a certified arborist with the International Society of Arboriculture.

Richard Singh, Ph.D.
Assistant Professor of
Sustainable Plant Production

Dr. Richard Singh joined UOG's College of Natural & Applied Sciences in July 2024. He will serve as an assistant professor of sustainable plant production as well as research faculty, focusing on pomology, under the UOG Land Grant agInnovation Research Center. His research will explore the development, enhancement, and physiology of fruit trees. He plans to utilize molecular markers to facilitate the breeding of new fruit tree varieties with desired traits, such as nematode resistance, improved yield, and climate adaptability. He holds a doctorate in bioscience engineering from Ghent University (Belgium) and an Erasmus Mundus M.S. in nematology from Wageningen University (Netherlands).

Dareon Rios, M.S.
Extension Agent II/Instructor of 4-H
and Youth Development

Dareon Rios joined UOG Land Grant in August 2024 as an extension agent with the 4-H Program. She brings a background in STEM – having studied genetics for her master's thesis at UOG and having worked as program manager and research associate for the TANICA breast cancer prevention project under the Pacific Island Partnership for Cancer Health Equity.

Within the 4-H program, she will be exploring the needs of Guam's diverse youth populations post-COVID and in a heavily tech-influenced environment and developing approaches for positive youth development. Rios holds a master's in biology with an emphasis on genetics from UOG and a bachelor's in human biology from the University of California San Diego.

SELECTED PUBLICATIONS IN 2024

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