

2010 University of Guam Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Guam, an unincorporated Territory of the United States, is located in the Western Pacific at 13 degrees north latitude and 144.4 degrees east longitude. It is the largest of 16 islands in the Marianas. It is approximately 3,600 miles west- southwest of the Hawaiian Islands and about 1,500 miles due east of Manila, Philippines. Guam's population is approximately 180,000 and rapidly increasing. It is estimated that population will increase to 220,000 within the next three years. The ethnic background of the island includes: Chamorro (native islanders), Filipinos, Caucasians (including members of the U.S. Armed Forces and their dependents), other islanders (Micronesians and Palauans) and Asians (Koreans, Japanese and Chinese).

The University of Guam as a member of the 1862 Land Grant institutions. College of Agriculture and Life Sciences (CALS) facilitates the tripartite functions of the college: research, extension and teaching. The Dean of CNAS serves as Director of the Agriculture Experiment Station, and also as Director of Cooperative Extension Service.

In 2006 AES was renamed to Western Pacific Tropical Research Center. This new name more accurately reflects the division's broad mission and research priorities. The primary mission of WPTRC is to conduct applied and basic research in agriculture and to protect the natural environment. The Hatch funds and their respective Government of Guam matching funds are used to maintain operations of the Western Pacific Tropical Research Center. These funds principally support the salaries of permanent personnel of WPTRC.

The Western Pacific Tropical Research Center conducts research for the protection of natural environment as well as the development of the island's agriculture and aquaculture. The University of Guam Cooperative Extension Service translates and delivers technical information and conducts informal education programs for farmers, homemakers, families, youth and the community.

Research productivity over last several years continuously increase. In 2010, ten full time researchers published over 20 refereed journal papers which place us among successful and productive research units. Further significant growth in refereed journal publications as well as substantial increase in successful grant proposals in 2010 was evident. The new aquaculture program resulted in development of a successful activities in both research and teaching. Creation of the new tenure track Chemical ecologist position assured stability in this important field of research. Investments related to the military buildup on Guam had positive impact on the island's economy and local businesses however increased number of introductions of pests and other invasive species. Overall, 2010 was a successful year for WPTRC.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	8.0	0.0
Actual	0.0	0.0	9.0	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Combined External and Internal University Panel

2. Brief Explanation

Because of the small size of WPTRC, review of individual projects was conducted by WPTRC administrators (Director and Associate Director). Planned programs and activities addressed the critical issues of strategic importance, including those identified by the stakeholders during the development of 2006-2011 Strategic Plans. All new research proposals were submitted to WPTRC Associate Director who checked proposals for completeness and format. Afterwards proposal were sent for review to external ad hoc peer reviewers. Based on the review, that includes assessment of (1) significance, (2) need, (3) approach, (4) new knowledge to be generated, (5) potential for impact, and (6) potential for success, WPTRC administrators are submitting proposals to CRIS and make decisions regarding allocation of resources.

III. Stakeholder Input

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

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to selected individuals from general public

Brief explanation.

In 2010, numerous research projects were driven by stakeholders demand and addressed environmental issues, integrated plant protection, biocontrol as well as served ethnic needs of local population. Relatively large portion of research aimed to develop control mechanisms for eradication/ suppression of non-indigenous/invasive species, to improve and implement effective early detection and prevention strategies, and to develop Integrated Pest Management strategies for major exotic insect plant pests and diseases. Another important research project continued to define the genetic structure of the Cycads populations among the island habitats of Guam, Rota, Yap, Palau, and the Philippines. We continued to focus on issues that assure the understanding and protection of natural environment and sustained management of precious natural resources waste management, water quality and other natural resources vital for people of Guam.

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

1. Method to identify individuals and groups

- Open Listening Sessions
- Other (Guam's stakeholders are well identified)

Brief explanation.

WPTRC researchers employed several input methods to solicit input from individual farmers, farmers groups, representatives of the industry and representatives from federal and local agencies. Because of relatively small number of faculty and stakeholders on Guam, it has been a long-lasting practice to invite stakeholders for various functions in the college and give them frequent opportunities to express their needs in informal settings such as personal contact with faculty members. In 2010 stakeholders (farmers, golf course superintendents, managers from nurseries etc.) were invited to the college numerous times to express their needs and concerns. Of particular importance is continued understanding and stakeholders' support on issues related to the natural environment.

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

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting with invited selected individuals from the general public

Brief explanation.

Guam's stakeholders are well identified. About fifty farmers who supplement their income with some sort of agricultural production ranged in their activities from substantial (full time farmers) to hardly significant. Their associations are rather loose and based on personal contacts, friendships, etc. Their research requests are consequently not strong however researchers are required to address farmers' concerns. Many researchers modified their research programs to improve a service to stakeholders and provided additional opportunities for continued feedback. Research Information were disseminated to communities through internet, printed newsletters, local newspaper coverage, radio and television programs.

3. A statement of how the input will be considered

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

Brief explanation.

We believe our informal and formal contact system with stakeholders works well. One example

of how stakeholder input is translated into action by CNAS is the rapid manner in which UOG is able to react to the sudden appearance of invasive species. Due to the close contact extension and research scientists maintain with local growers, and because of the breadth of experience on other islands in the region, UOG-CNAS scientists and extension agents are able to identify, characterize and provide a rational method of management for invasive species, new disease outbreaks and other concerns on Guam. After identifying challenges researchers apply for funding for more in depth investigations for example on the nature and optimal management technique to contain diseases or invasive species.

Brief Explanation of what you learned from your Stakeholders

For the most part, our professionals know the primary stakeholders in their particular disciplines, and interact with them regularly in the course of their normal university duties. Input from these interactions allows the faculty to tailor their programs to the unique needs of Guam's diverse community. Because Guam is a small island where most business is transacted in an informal setting, we felt it necessary during 2010 to introduce a more structured and easily evaluated format for obtaining community input into faculty endeavors.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	976992	0

2. Totaled Actual dollars from Planned Programs Inputs				
Extension			Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	840000	0
Actual Matching	0	0	700000	0
Actual All Other	0	0	0	0
Total Actual Expended	0	0	1540000	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	0

V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Sustain, Protect, and Manage Guam's Natural Environment and Resources.
2	Development and Protection of Guam's Diversified Tropical Plant Systems, and Aquaculture.

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Sustain, Protect, and Manage Guam's Natural Environment and Resources.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships			100%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.0	0.0
Actual	0.0	0.0	1.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	95000	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	50000	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Soil management practices for agricultural sustainability and environmental quality study continued on the Island of Guam. An integrated approach was designed and is being used to evaluate the long-term effect of no-till (NT) and other conservation tillage practices such as crop rotation with a leguminous plant for organic matter build-up and residue management for soil rehabilitation and restoration of the badlands in southern Guam. The no-tillage practices proved very effective for erosion-control technique, as was

indicated by the measured infiltration rates that were compared with the other experimental treatments, but the no-tillage treatment plots have not been able to produce competitive yield as compared with other treatments. This result reveals that, the no-tillage techniques may not be attractive to farmers for short-term practices. A useful compromise seemed to be the reduced-tillage (RT), which not only produced higher yield but also proved to be quite effective in reducing runoff, and increased infiltration, hence reducing water erosion from these severely eroded soils of southern Guam. Conventional tillage accompanied by rotation with sun hemp (a leguminous crop) also produced relatively higher yields than conventional till with no crop rotation. Conventional till with crop rotation was also relatively effective in reducing soil erosion, and rotation with sun-hemp proved valuable as sunhemp worked as green manure and was effective contributor to soil organic matter enhancement. Also, it was shown that the soil organic matter as well as soil organic carbon, soil erosion, and soil water supply are all affected by the conservation tillage practices. the study showed that, in addition to soil quality improvement, the conservation tillage systems also affect the amount of soil carbon sequestration and/or carbon dioxide emission into the atmosphere.

In 2010 a study on carbon sequestration and distribution in soils of eroded landscapes continued. This study investigated the impact of long-term conservation and residue management based cropping systems on Soil Organic Carbon (SOC) levels and soil carbon sequestration on the tropical conditions of the western Pacific island of Guam. Conservation practices, especially No-till, restore SOC and have the added benefit of controlling erosion. The challenge facing soil and agricultural scientists is to develop practical strategies for agricultural productivity while restoring soil organic carbon in tropical agro-ecosystems and at the same time arresting ongoing water erosion in degraded areas of southern Guam. This study specifically examines conservation and restoration strategies that address crop production needs within a framework of increasing environmental and financial constraints of the island's farmers and ranchers. Up to date study results have shown that the higher percent carbon content of the soil under the no-tillage (NT) was due to no disturbances to the soil surface during the study period. On the reduced till (RT) plots the percent carbon content also remained high next to the no-till plots mainly due to the reduced disturbances as compared to conventional tillage (CT) practices. On the other hand, it was shown that the percent carbon content in the conventional tilled (CT) plots were the lowest for all sampling events so far while the conventional tilled with sun hemp (CT/SH) rotation had higher carbon mainly due to the green manure effect that added organic matter as well as carbon to soil as the result of sun hemp biomass production and incorporation between the main crops as rotating crop. Also, the carbon content of the soil was considerably higher in the lower depths regardless of the tillage treatment however; the overall carbon content of the soil under CT is generally lower due to continuous disturbances of the soil surface and within the tillage depth. Furthermore the data illustrates that the carbon content of the soil near the surface is less than % 1.5 for all treatment regardless of the tillage practices. This could be due to the fact that the carbon sequestration potential of the soil is inadequate near the soil surface. On the other hand, the carbon content of the soil is higher at depth below the 8 inch indicating possibility of carbon release in the form of carbon dioxide or any other forms of carbon compound which is relatively low in lower depth, due to the less disturbances and more stability condition at the deeper soil matrix.

The results of this ongoing experiment will contribute to the overall scientific efforts in understanding the role of agriculture in sequestration of carbon in soils, and the ways in which this may reduce atmospheric carbon dioxide. It also provides information pertaining to the local conditions of the island tropical climate as relates to carbon sequestration or carbon loss in the form of carbon dioxide emitted into the atmosphere following each disturbances that occur during the tilling process.

2. Brief description of the target audience

The results of this ongoing experiment will contribute to the overall scientific efforts in understanding the role of agricultural practices in soil and water conservation and natural resource preservations and

protection. Also, the result of this and similar studies will provide more insight for the understanding of the carbon storage capacity of soils especially under the tropical conditions of Micronesia and islands of the western pacific. Up to date information is being disseminated among scientists and producers via conference presentations and informal field visit and demonstrations. The research plots from this project are also being used as teaching tool for the students of biology and agricultural sciences during the course of study periods. The students of AG 380 and 481 are being taken to the research site so that they could observe the field as well as the laboratory analysis from each tillage treatment which was explained to them during each site visit. Following each field visit the result of experimental techniques were provided to the students and they were asked to write a report about each treatment and describe their observations regarding the effect of conservation techniques on soil properties and especially as relates to carbon sequestration and carbon storage capacity of the soil under each different treatment observed. This process has been very educational and rewarding as the students of agricultural and biological sciences can see and understand the effect of various conservation techniques not only on farming and production capability of the soil but also on carbon sequestration and related environmental issues affecting the other natural resources.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	20	200	50	100

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

Patent Applications Submitted

Year: 2010
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	1	1

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Conference Presentations

Year	Actual
2010	3

Output #2

Output Measure

- Journal Publications

Year	Actual
2010	1

Output #3

Output Measure

- Newspaper, magazine and other non peer reviewed publications.

Year	Actual
2010	2

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Adopt sustainable natural resource management practices. Enhance the environmental sustainability of Guam's natural resources. Learn about water and land interaction, and related water-quality issues

Outcome #1

1. Outcome Measures

Adopt sustainable natural resource management practices. Enhance the environmental sustainability of Guam's natural resources. Learn about water and land interaction, and related water-quality issues

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Environmental sustainability is of interest to most Guam's residents

What has been done

Presentations, papers, workshops, field day.

Results

Knowledge has increased, farmers and students observed results and learned.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes

Brief Explanation

Overall poor economy and cuts of local appropriations influenced outcomes.

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

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Development and Protection of Guam's Diversified Tropical Plant Systems, and Aquaculture.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
202	Plant Genetic Resources			20%	
205	Plant Management Systems			10%	
211	Insects, Mites, and Other Arthropods Affecting Plants			20%	
212	Pathogens and Nematodes Affecting Plants			10%	
215	Biological Control of Pests Affecting Plants			10%	
216	Integrated Pest Management Systems			10%	
307	Animal Management Systems			10%	
601	Economics of Agricultural Production and Farm Management			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.0	0.0
Actual	0.0	0.0	7.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	745000	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	650000	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Conservation of local lines of sweet potato and chili pepper continued. Seed distribution to clients is on-going activity including heat tolerant commercial cucumber seeds and local corn seeds. Fifteen accessions of sun hemp were obtained. Conservation and evaluation of important tropical plant germplines will support development of sustainability agriculture in the region.

Study on the influence of trade winds on papaya culture on Guam continued. This research is crucial for understanding the biomechanics of papaya and how wind exposure modifies the biomechanics.

Production of local seeds and tissue-cultured plants in improvement of vegetable production on Guam study continued. Seeds of local hot pepper were collected for distribution in 2010. Local pumpkin seeds were also re-generated at a collaborating farmer's field.

Collection, evaluation and culture of ornamental plants in Guam focused on evaluating wildflower seed mixes that are being imported into Guam.

Integrated pest management of aphids and whiteflies on cucurbits and vegetables on Guam was studied in 2010. DNA extraction techniques for aphids, and BBTV ELISA protocols have been developed and refined for use in our UOG entomology laboratory.

Research addressing the development of sustainable aquaculture on Guam continued. An eight-week experiment was conducted to evaluate the genetic and dietary protein level/source interactions for Pacific white shrimp, *Penaeus vannamei*. Over 50 shrimp families were produced in year 2010 by artificial insemination, to maintain the genetic diversity and the platform for continuous shrimp genetic research.

Research on diseases of traditional Pacific island crop plants continued in 2010. Various banana cultivars were imported in tissue culture from Belgium and Fiji. A plan to survey the island of Guam for the Coconut viroid is under way.

Development of efficient semiochemical-based control methods for weevil pests on Guam continued in 2010. Field and laboratory studies have explored the effects of trap characteristics such as design, size, color, visual and olfactory cues, and location on capture of *R. obscurus* in date palm plantations and ornamental nurseries.

Phytochemicals, biological properties, and safety of tropical and subtropical foods, plants, or herbals in the Western Pacific was studied in 2010.

The optimum conditions of pasteurization and quality of the soursop puree during storage under refrigeration were determined.

A small-scale integrated farming system in an insular urban environment research continued in 2010. On-farm demonstration of non-circulating hydroponic system showed the potential of leafy greens production using simple hydroponic system in the tropics.

Research progress studying forest litterfall storage pools and turnover on Guam was made in 2010. Emphasis this year was placed on defining how several invasive insects have altered the litter quality and habitat chemistry by selective infestations of *Cycas micronesica* foliage.

UOG food scientist researched beneficial and adverse effects of natural, bioactive dietary chemicals on human health and food safety. A new method of "freeze-juicing" to prepare fresh noni juice was studied.

Biological control in pest management systems of plants was studied by entomologist. Populations of the spiny soldier bug, *Podisus maculiventris*, have been established in quarantine and host specificity testing has begun.

In 2010, UOG chemical ecologist conducted survey to develop management practices for invasive plant species in Guam. The risk assessment for the 20 most widespread invasive plants identified on Guam and the best management practices available for them.

2. Brief description of the target audience

Our target audience are research community, federal and territorial agencies, farmers, landscapers general public etc.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	30	100	20	100

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

Patent Applications Submitted

Year: 2010

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Actual	0	20	20

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Journal publications

Year	Actual
2010	20

Output #2

Output Measure

- Newspaper, magazine, and other non peer reviewed publications.

Year	Actual
2010	35

Output #3

Output Measure

- Abstracts and conference presentations.

Year	Actual
2010	45

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Action outcomes Adopt healthy lifestyle practices, Adopt independent living practices, Adopt sustainable living practices, Adopt sustainable natural resource management practices, Implement food safety practices at all stages of the food handling system, Improve and expand Integrated Pest Management. Condition Outcomes: Enhance the economic and environmental sustainability of Guam's agriculture and aquaculture. Improve the lives of Guam's citizens through positive human development, healthy lifestyles and nutrition Learning Outcomes Aspire to contribute to ecological health and biodiversity Learn about integrated pest management (IPM) Learn about invasive species Learn about IPM technologies and benefits Learn about new crops and varieties Learn about nutrient sources, recycling and delivery methods that are compatible with crop, soil and production systems Learn about principles of aquaculture resource management Learn about the environmental risks of handling and applying pesticides Learn about the risks of not handling food safely Learn about water and land interaction, and related water-quality issues Learn alternative pest management techniques that minimize pesticide use Learn appropriate food safety practices Learn proper food handling practices Learn sustainable living skills Learn to apply pesticides safely and effectively Learn to identify invasive species

Outcome #1

1. Outcome Measures

Action outcomes Adopt healthy lifestyle practices, Adopt independent living practices, Adopt sustainable living practices, Adopt sustainable natural resource management practices, Implement food safety practices at all stages of the food handling system, Improve and expand Integrated Pest Management. Condition Outcomes: Enhance the economic and environmental sustainability of Guam's agriculture and aquaculture. Improve the lives of Guam's citizens through positive human development, healthy lifestyles and nutrition Learning Outcomes Aspire to contribute to ecological health and biodiversity Learn about integrated pest management (IPM) Learn about invasive species Learn about IPM technologies and benefits Learn about new crops and varieties Learn about nutrient sources, recycling and delivery methods that are compatible with crop, soil and production systems Learn about principles of aquaculture resource management Learn about the environmental risks of handling and applying pesticides Learn about the risks of not handling food safely Learn about water and land interaction, and related water-quality issues Learn alternative pest management techniques that minimize pesticide use Learn appropriate food safety practices Learn proper food handling practices Learn sustainable living skills Learn to apply pesticides safely and effectively Learn to identify invasive species

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	10	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

{No Data Entered}

What has been done

{No Data Entered}

Results

{No Data Entered}

4. Associated Knowledge Areas

KA Code Knowledge Area

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes

Brief Explanation

Overall poor economy and reduced local appropriations influenced outcome but we still had very successful year.

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

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}