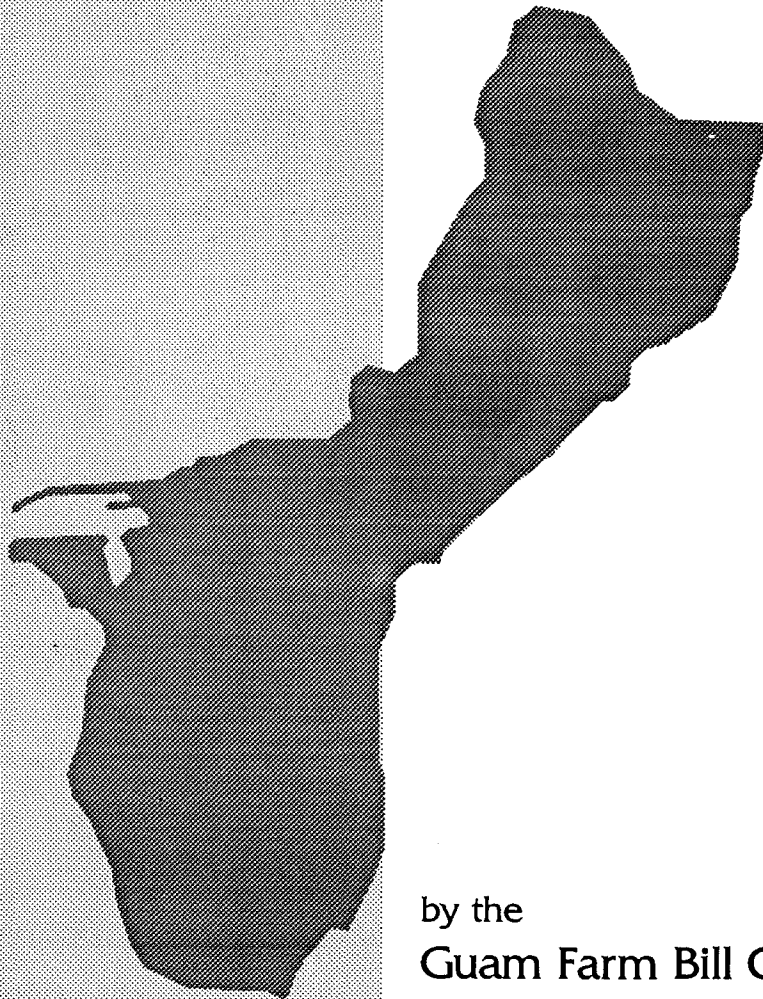


Prem Singh

**PROCEEDINGS
OF THE WORKSHOP ON**

The
Future of
Agriculture
on Guam



by the
Guam Farm Bill Committee 1995

INTRODUCTION

Competition for scarce land and water resources promises to dominate public dialogue and decisions about future development in coming years. Agricultural resources, on land and in water, should be key components of this discussion.

To encourage more public debate on the future of agriculture on Guam, a forum was held on May 13, 1995. Its intent was to gather together political leaders, federal and local government officials, farmers, educators and others interested in the environment for a round-table discussion. The following are some of the keynote presentations from that forum.

We extend our thanks to the generous sponsors who made this event possible. They include the University of Guam's College of Agriculture and Life Sciences, the Natural Resources Conservation Service (USDA), the Guam Farm Bill Committee, the Guam Department of Agriculture, the Guam Soil and Water Conservation Districts, and the Red Carpet Restaurant.

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AGENDA FOR MAY 13, 1995 FORUM

Is there a Future for Agriculture on Guam?

8:00 a.m. Registration

8:30 a.m. Welcoming Remarks
Mr. Michael Kuhlmann
Director, Guam Department of Agriculture

Introductory Remarks
Don Farrell for the Hon. Gov. Carl T.C. Gutierrez

9:00 a.m.- 10:30 a.m.

Session I **Agricultural Land Development: Now and the Future**

Moderator: Dr. R. Muniappan

Panelists: Sen. Angel Santos
Sen. Ted Nelson
Mr. Joseph Borja, Executive Director, CLTC
Mr. Naciso Custodio, GEPA

10:30 a.m. to 12 noon

Session II **Aquaculture: Present and Future**

Moderator: Sen. Ben Pangelinan

Panelists: Sen. Joe T. San Agustin
Sen. Mark Charfauros
Mr. William Fitzgerald, Department of Commerce
Mr. Rufo Lujan, Department of Agriculture
Mr. Gary Stillberger, GEPA

12:00 noon Lunch

12:30 - 2:00 p.m.

Luncheon Speaker: **Value Added Marketing**
Sen. Joe T. San Agustin

2:00 - 3:30 p.m.

Session III **Marketing**

Moderator: Dr. Jeff T. Barcinas

Panelists: Mr. Frank Aguon Jr., Director of Commerce
Mr. David Tydingco, President, Guam Hotel and Restaurant Association
Mr. Richard Cook, Commissary Officer

3:30 p.m. to 5:00 p.m.

Session IV **Water Quality and Agriculture**

Speaker: Mr. Doug Knox

Agriculture: Guam's Legacy

**Vice-Speaker Sen. Ted S. Nelson
23rd Guam Legislature**

Good morning and Hafa Adai!

I call your attention to one of the most historic events in this Century which occurred on December 17, 1903, in the State of North Carolina. I am referring, of course, to the great achievement of the Wright Brothers in the discovery of heavier-than-air flight. In their joy and excitement, they immediately transmitted a telegram to their sister in Tennessee, which read: "First sustained flight today. Twelve seconds. Home for Christmas." Their sister, also in her excitement and being profoundly aware of this remarkable feat, rushed to the local newspaper and submitted the telegram to the editor. This was the headline the following day: – "Wright Brothers home for Christmas!" – thereby, missing an opportunity to report an exclusive announcement of what was the pioneering effort of the modern airplane in today's age. What was the difference? What was the distinct separation of the outlook of the Wright's sister and the newspaper editor? It was in the vision they perceived of the personalities and the event itself.

I just hope to God that we who are here today attending this milestone event in agriculture on Guam have the proper vision for what is to be the result of the discussions and actions of this workshop.

Earlier this week, I was deep in thought as to how desperate our island needs leadership in every area, every sector of our economy. We here are all in some capacity of leadership. Somehow, we, starting with myself, need to rededicate ourselves to principles, especially in such a vital part of our island society as agriculture, so much so that we become courageous enough to do right rather than what is convenient.

This mountain climber lost his footing and fell part way down the side of the mountain before he managed to save himself by grabbing a branch with one hand. He couldn't scramble back up so he prayed to God for help. Suddenly, a voice came from on high and said, "I am the Lord thy God, how can I help you?"

"Oh, God, I'm stuck here and I'm hoping to fall," said the climber.

"Do you believe in me?" God asked.

"Yes. Yes. I believe in You," responded the climber.

"Do you have complete faith in me?"

"Yes. Yes. I believe in You."

"Then I will save you. Let go of the branch," the voice ordered.

There was a moment of silence, then the climber said, "Excuse me, but is there anybody else up there?"

I wish to acknowledge the sponsoring organizations of this timely workshop: the College of Agriculture and Life Sciences of the University of Guam, the Natural Resources Conservation Service (USDA), Department of Agriculture, the Guam Farm Bill Committee, the Guam Soil and Water Conservation District, and the Red Carpet Restaurant.

As I stand here, I stand in absolute support of agriculture as an existing and viable industry, and farmers, their families and their farmhands as an integral part of the Guam economy! I am a product of a family farm in the onetime small village of Yigo. I grew up on a farm. In fact, everyone on Guam back then, even in Agaña or Sumay, had farms in the hills or in the remote villages.

As I look out over audience this morning, I am reminded of prominent and pioneering farmers in the past and some who still savor the satisfaction of tilling the soil, planting the seeds, watering the plants, and harvesting the crops so that their families, their relatives, neighbors and households in the villages could cook meals with local ingredients and in the traditional manner. Somehow, this is one aspect of our Chamorro culture and Guam lifestyle that seems to fade by the wayside. I think of Mr. Fred Quitugua of Yigo, Tun Ramon Benavente of Dededo, and Tun Jesus Baza of Merizo. I also wish to recognize those who have been directors of the Department of Agriculture in

years past such as Tony Quitugua, Frank Aguon, and Jose Barcinas.

Is there a future for agriculture on Guam?

This question before this Forum requires the wisdom of a Solomon. The diligence and perseverance of the hardest working farmer, yet with the pure heart of a child to hope and pray that agriculture and the fruits, vegetables and livestock that it produces are essential for the tables of our families on Guam, from Merizo to Yigo.

This workshop was born out of the ashes of adversity. The hard times facing the farmers are indicative of the difficulties in our economy and the restless time we live in. The initiators of this gathering, I believe, were prompted to rise up and be counted in making a genuine endeavor to assess agriculture today, to help make decisions, and to act on them on behalf of the small yet essential sector of our community, the farmers who persevere to raise fresh vegetables, fruits and meat at reasonable prices.

The first response I have is to ponder on whether or not we as a society can afford not to have agriculture as a viable industry within the Territory of Guam.

We are agreed that agriculture is vital and must continue to exist. Historically, Chamorros have been agrarian people throughout all of the recorded 400 years of the Spanish Era and into the first 40 years as a possession of the United States under Naval government administration, and then into our early years as an unincorporated Territory. However, somehow, the number of farms and families planting gardens, raising chickens and other agricultural activities, has decreased as the move continues into government jobs and other fields/industries of the private sector.

First and foremost, I say we must hold on to the existing farms we have today. Let me give you an example of what we don't want to happen. There was this farmer up in Yigo who had borrowed heavily on his ranch property and went to the banker and said, "I can't meet my note for \$8,000 that falls due on Wednesday because of the heavy rains of last month which ruined all my vegetables. You'll have to give me an extension."

"I can't give you an extension," the bank told the farmer. "The rains hit everyone and you'll have to pay off the note on Wednesday."

"I don't think you understand the problem," the farmer told the banker. "Were you ever in the business of growing vegetables?"

"No," said the banker.

"Well," returned the farmer, "starting next Wednesday you will be!"

Secondly, we must support all areas of the mission, goals, and mandates of the Department of Agriculture. The Forestry and Soil Resources Division has services which impact on soil and forest conservation and restoration. Public Law 20-176, which I authored, establishes an Agricultural Board of Commissioners, thus increasing public input into government. The Legislature continues its support via annual appropriations of farm services such as the low agricultural water rate, the farm equipment subsidy program, and the Farmers and Fishermen Small Loan Revolving Fund. (P.L. 20-105).

Third, it is imperative that we evaluate our policies on agricultural land development.

Fourth, encouragement of agriculture land leases must be placed in the mainstream of the Department of Agriculture. While it must have the cooperation of the Chamorro Land Trust Commission, it must be driven by the entity with agriculture as its primary mission.

Fifth, I urge you in leadership in this field to continue interaction with the 16 or so farm cooperatives around the island as well as to increase your interaction with the mayors, vice-mayors and the municipal planning councils.

Sixth, in conjunction with the situation facing the Territory concerning the impact of the Compacts of Free Association between the United States of America and the Republic of the Marshall Islands, the Federated States of Micronesia and, just recently, with Republic of Palau, I propose to you to utilize our island neighbors, especially the young men, in helping us work the fields, in planting the seeds, and in attending to the hogs, cows, and chickens. This would be a win-win situation in which we assist them to assimilate into our society while they help us on our farms.

Lastly, I strongly recommend to the director and management staff of the Department of Agriculture to reassess (the agency's) mission and direction and to work from these proceedings along with University's College of Agriculture and Life Sciences, the presentations here today, and with further research, decide on a plan of action wherein territorial leaders would use as a basis for budgetary and policy mandates.

At this time, as acting president of the Association of Pacific Island Legislatures (APIL), I encourage each of you to enlarge your vision to stretch out to our neighboring Islands in Micronesia. I refer, of course, to the Federated States of Micronesia (the states of Chuuk, Kosrae, Pohnpei and Yap), the Marshall Islands, and the Republic of Palau. On behalf of APIL, I am pleased to announce that this July, APIL will convene its 14th General Assembly in the state of Pohnpei, Federated States of Micronesia. Regional issues, such as agriculture, are on the agenda.

I am reminded of what Andrew Carnegie once said, and I quote, "No man will make a great leader who wants to do it all himself, or to get all the credit for doing it." By this workshop and other events similar to this, each of the sponsoring organizations has displayed its concentration, interest and support of agriculture as a whole. Keep it up! Bring the results of the discussions here today to the rest of the island community. Let the governor know, and allow entrepreneurship to rise to the surface as well. I will do my part along with the other senators here to advocate agriculture more and more in our sessions.

We hope to do what is right and just for all of us.

I, therefore, pledge the full cooperation of the Office of the Vice-Speaker and the Committee on General Governmental Operations and Micronesian Affairs to assist and support this conference, its resulting work, all the organizations involved in the agricultural industry, and most especially to each of you as farmers, farming advocates, government leaders and managers, for the good of the ultimate consumers, our dear people of Guam.

I challenge each one of us to look to one another, for we can not function as isolated beings or as disfunctioning entities. We must seek to help and advice from each other so that our meager resources on Guam can be maximized and that our hope for future of agriculture on Guam can be realized in our lifetime.

I return to the illustration of the first media response to the historic accomplishment of Wright Brothers back in 1903. Which do we desire to associate ourselves with— with the sister who saw the vision and potential of air flight or the shortsighted newspaper editor who only saw a family reunion?

I urge every one of us to take the right vision, endeavor to make the right decisions, and continue our efforts in farming, in agriculture, for the good of Guam.

Therefore, to the purpose of this paper, I must respond: Yes, I believe there is a future for agriculture on Guam!

Thank you and Si Yu'os Ma'ase. ❖

An Agricultural Introduction to the Chamorro Land Trust Act

Joseph Martinez Borja, administrative director
Chamorro Land Trust Commission

Is there a future for agriculture on Guam? It seems strange that the Chamorro Land Trust Commission should be answering that question. The Chamorro Land Trust Act is a copy of the 1921 Hawaiian Homes Commission Act, enacted by the US Congress as a government-sponsored homesteading program. This act was adopted into the Constitution of the State of Hawaii as a requirement of the Admissions Act when Hawaii became a state in 1959. The Department of Hawaiian Homelands is now a state agency.

The Chamorro Land Trust Act was enacted into law in 1975, probably a more agricultural time than today. Although the Act was enacted into law in 1975 it was never implemented until 1993.

The Chamorro Land Trust Act is probably more of an agricultural act than a homestead act or residential housing act. The act has several agricultural aspects:

- ✓ It requires the Commission to assist lessees in farming, ranching and marketing of agricultural produce and livestock.
- ✓ It limits agricultural uses to tracts of land not to exceed 20 acres.
- ✓ It limits grazing uses to tracts of land not to exceed 50 acres.
- ✓ It requires the Commission, when practical, to establish community pastures.
- ✓ It sets rental of these tracts at \$1 a year.
- ✓ It sets the lease term of these tracts at 99 years.
- ✓ It requires the planting and maintenance of a certain number of trees per acre for the first four years of the lease. Type of trees to be approved by the Department of Agriculture.
- ✓ It allows the mortgaging of these tracts to other Chamorros and governmental agencies (loans).
- ✓ It exempts an original lessee for all taxes for the first seven years of the lease.
- ✓ It provides for a Commercial Loan Fund that may be used for agricultural ventures.
- ✓ Although the Chamorro Land Trust Act primarily allows leases only to native Chamorros, as defined by the Act, there is a provision for leases to the general public.

Loss of Authorization to Lease Land

According to an Attorney General's opinion, the Department of Agriculture has lost its authorization to lease land upon the implementation of the Chamorro Land Trust Act.

Definition of Agricultural Activity

One thing the Chamorro Land Trust Act does not do is differentiate between subsistence farming, truck farming or commercial farming, especially for leasing purposes.

Rules and Regulations for Agricultural Leases

The Rules and Regulations for agricultural leases are going through the Administrative Adjudication Act process. The Commission expects to transmit the final draft to the 23rd Guam Legislature during the last week of May 1995. The Legislature then has 45 calendar days and seven legislative days to act on the Rules and Regulations. These rules and regulations are setup primarily for the subsistence farmer and not the commercial farming operations. Commercial farming operations lease requests still have to be reviewed by the Commission.

The Act does not seem to address lease rates for commercial farming operations. The Commission is concerned that lease rates seem to be the same for subsistence farmers as well as for commercial farmers.

Inventory of CLTC Lands Available for Agricultural Use

The Chamorro Land Trust Commission Available Lands Inventory contains 320 lots that total 9,900 acres. These lots were transferred to the Commission after all the departments in GovGuam

reserved lands during public hearings in June 1993. These "reserved lands" are listed in Public Law 22-18. However during that reservation process, three departments did not receive any land at all: the Department of Parks and Recreation, the Mayors' Council and the Department of Agriculture. All existing valid Department of Agriculture leases continue and remain in effect. The Chamorro Land Trust Commission does not have any jurisdiction over those "valid" leases. This is discussed in the next section.

Of the 320 lots in the Available Lands Inventory, approximately 142 merit review by the Commission and the Soil and Water agencies to determine if these lots are suitable for some sort of agricultural or grazing activity. These 142 lots total approximately 9,029 acres. Those that are prime agricultural lands can then be reserved by the Commission for agricultural use. Residential leases do not necessarily have to be on these lands.

Review of Existing Occupants

The Department of Agriculture is currently undergoing a review of all its files to establish a list of "valid" Department of Agriculture leases.

Throughout the years the Department of Agriculture has issued various types of "authorizations" to use GovGuam lands under its jurisdiction such as provisional leases, temporary permits that became permanent and Director's authorizations. Other than "valid" existing leases, most of these authorizations are invalid and are of no effect or, at the very least, temporary.

A land area "utilization review" should also be done. If 10 acres are being used, are all 10 acres being utilized? The Department of Agriculture has already begun identifying lots that should be in the Available Lands Inventory of the Chamorro Land Trust Commission.

The Chamorro Land Trust Commission has also found qualified and non-qualified existing occupants of its properties used for agricultural purposes.

The Commission has also begun a review of "in-progress" applications for surveyed lots when the Chamorro Land Trust Act was implemented in March 1993. These will possible be handled by the Commission on a case by case basis.

Future Plans

While the first two survey projects for the Commission will be for residential subdivisions, there are several agricultural lots ready for leasing or are presently occupied without leases but used for bona fide agricultural purposes. Most of these lots are in the Astumbo area. These lots can be leased by the Commission as soon as the Rules and Regulations are promulgated. There are also 82 lots that are one acre or less in total size, 58 of these might be suitable for agricultural use. If suitable for agricultural use these lots are ready for lease once the Rules and Regulations are promulgated. Other lots larger than 20 acres can be ready (parcel surveyed) in a few months if funding is identified or provided.

Funding for the surveys of these lots is provided by the rent proceeds from the Guam Municipal Golf Course lease (currently approximately \$242,000). Another \$250,000 has been appropriated to the Department of Land Management for a new survey crew and equipment reserved exclusively Chamorro Land Trust property surveys.

Lot 421 Talofof

This lot has been reserved for agricultural use by CLTC Resolution. It has also been identified and lined up for a parcelling survey by the Commission. There are presently 17 families using the lot as a residential area (Tajeron Heights). The Commission is working with the Mayor of Talofof to designate a residential area to move and accommodate these 17 families in order that the lot be used exclusively for agricultural purposes. The parcelling survey is scheduled to begin in approximately nine months (February 1996). Total availability lot area is 79 acres.

Tract 1021 Dededo

This lot has already been surveyed for agricultural leasing. However, it is located over a water aquifer in Dededo and the EPA has limited agricultural activity to organic farming. Total available lot area is 544 acres. There is presently existing agricultural and residential activity on this lot. In order for agricultural leasing to take place on this lot, EPA concerns and approval have to be obtained.

Lot 7150 Yigo

This lot has been identified by previous executive order as a low-risk area relative to the water aquifer. There is existing agricultural, grazing and residential activity on this lot. It is next to the slaughterhouse lot in Yigo. Total available lot area is approximately 160 acres.

Wetlands/Aquaculture

There are five lots in the Available Lands Inventory that may be suitable for aquaculture use (one in Agat, three in Yona/Pago Bay and one in Chalan Pago/Pago Bay).

Action Needed

There are several items of actions that need to be addressed to assist and continue agriculture on Guam:

By the Chamorro Land Trust Commission:

- ✓ with the Department of Agriculture, define the various levels of agricultural activity for leasing purposes,
- ✓ with the Department of Agriculture, coordinate the application process, plans and inspections especially of the commercial farm operations,
- ✓ with the Soil and Water Conservation Districts, initiate a lot by lot review of land suitability for agricultural use.

By the Department of Agriculture:

- ✓ complete the file review for valid leases,
- ✓ initiate a utilization review of those valid leases,
- ✓ coordinate field inspections of existing properties under lease to determine jurisdiction.

By the 23rd Guam Legislature:

- ✓ provide permanent staffing and funding of Commission in order that the Commission can carry out its agricultural programs,
- ✓ clarification and definition of lease rates for commercial farm operations,
- ✓ review of Chamorro Land Trust Act mechanics.

By the Guam Environmental Protection Agency:

- ✓ determine the agricultural status of Tract 1021 Dededo,
- ✓ confirm the low-risk aquifer status of Lot 7150 Yigo. ❖

Agriculture and the Environment

Narciso Custodio
Guam Environmental Protection Agency

Agriculture on Guam is currently overshadowed by the tourism industry and government jobs. Major factors affecting Guam's agricultural industry include water, nonpoint source pollution and stormwater, labor, marketing, education, and pesticide use.

From the standpoint of the Guam Environmental Protection Agency and for today's workshop, our concern will be on those factors that we have direct oversight singly or along with other departments and agencies, be it federal or local.

One of the major concerns is stormwater and nonpoint source pollution of agricultural and other areas that contribute solids, nutrients, pesticides, and pathogenic organisms to island's receiving waters.

The US Department of Agriculture (USDA) administers programs that address agricultural NPS problems. These programs are managed by the Natural Resources Conservation Service (NRCS) which provides, among others, education, technical assistance and funding. USDA programs do not set specific regulatory controls on agricultural practices to prevent, reduce or diffuse source pollution. Rather, they provide technical assistance and cost-sharing-based funding to farmers for implementing agricultural Best Management Practices (BMPS), such as animal waste control systems, conservation, tillage, vegetative buffer strips, and filter strips.

Another factor affecting agriculture on Guam is the use of pesticides. For years now the Guam EPA, in coordination with University of Guam's College of Agriculture and Life Sciences, regulates the use of restricted - use pesticides by offering public education and outreach pesticide programs to the community. Private (farmers) and commercial pesticide applicator training workshops are offered at the College of Agriculture and Life Sciences (UOG/CALS) on a quarterly basis. To ensure safety and proper use of potentially hazardous pesticides (RUPs) farmers as well as commercial agricultural users are required by law (10 GCA, Chapter 50) to maintain or log and submit to Guam EPA a complete copy of routine operational records containing information on kinds, amounts, uses, dates and crops applied by restricted-use pesticide (RUPs) for the calendar year.

In addition, Guam EPA has recently developed the Worker Protection Strategy (WPS), a program designed to protect agricultural workers and pesticide handlers against health problems associated with the use of pesticides and other related agricultural chemical products. A copy of the WPS Safety Manual, translated in Chamorro, is available at the UOG/CALS and the Guam EPA. The Natural Resources Conservation Service has constructed two pesticide mixing stations in the North. At present these mixing facilities are being utilized by the farmers. There is a need to construct the same facilities in the South.

Some farmers would like to achieve a sustainable agriculture without the quest for efficiency and trying to farm within more responsible boundaries. Sustainable agriculture is a goal rather than a rigidly defined set of practices. A sustainable farmer must achieve both economic and environmental goals.

In general, sustainable farmers should focus on reducing chemical dependency: The most common ways to reduce use of synthetic fertilizers are:

- ✓ using animal manures and soil enriching plants called "green manures" to provide nutrients required by crops;
- ✓ using crop residues and deep-rooted forage crops to build soil organic matter and provide nutrients;
- ✓ applying commercial fertilizer and pesticides on an "as needed" basis, only after soil tests, visual scouting for pests, or other management practices;
- ✓ substituting mechanical cultivation and crop rotation for herbicides to achieve weed control.

Using ecological practices, sustainable farmers fuse low-impact, long-term practices instead of high-impact, short-term inputs. Good examples are:

-
- ✓ rotating crops to provide a well-planned sequence of complimentary plants to break pest cycles and enhance soil quality;
 - ✓ integrating livestock and crop production to make use of soil-building forage and hay crops and to provide manure fertilizer for nutrient-demanding row crops like corn;
 - ✓ managing landscape of alternating strips of soil-conserving and soil depleting crops, planting trees to reduce moisture loss and wind erosion, and other means.

All these practices take time to implement. They also require timely field operations and demand highly skill management. Sustainable farmers must carefully match farming practices to specific fields and, within fields, to specific soils they have diverse and changing land uses, more contour to fields, and more texture to the landscape.

The key for a successful agricultural industry can be attained through coordinated efforts of involvement from both local and federal agencies as well as private entities and public participation. It must also be economically and environmentally friendly with controlled irrigation system and implementation of pest management practices for the protection of the island's water resources.

For your information, the Guam Environmental Protection Agency (GEPA) and the Guam's Soil & Water Conservation Districts (GSWCDs) are working on formulating a memorandum of understanding (MOU) of partnership in order to develop a strategy and to formalize cooperation between agencies involved with natural-resources protection to reduce nonpoint source pollution and improve water quality (together with watershed health) to benefit our environment, economy and future. ❖

AQUACULTURE: PRESENT AND FUTURE

Opening Remarks

Sen. Vicente C. "Ben" Pangelinan
Guam 23rd Legislature

Today, the growth of the aquaculture industry has a solid foundation from which to build upon. The good work of the Guam Aquaculture Development and Training Center of the Department of Commerce in the development of the brood stock for commercial aquaculture farmers has greatly contributed to the industry. The recent passage of legislation which will establish a one-stop aquaculture permit center will greatly reduce the bureaucracy associated with the procurement of the necessary permits for the establishment of an aquaculture farm on Guam.

These and other actions by the government that support the industry will allow the industry to grow beyond the limitations of today. We can expand the species presently commercially grown to supplant the import market. The availability of loan programs from GEDA and the Department of Agriculture will assist local entrepreneurs in their efforts to penetrate the market. The support are present, we need to harness the political will to make it happen. ❖

Cutting the Red Tape

Sen. Mark C. Charfauros
23rd Guam Legislature

As a policy maker and also as the Chairman of the Aquaculture Industry Advisory Committee, I have made the enhancement of Guam's aquaculture industry a priority. For this reason, I have supported the passage of Sen. Ben Pangelinan's bill to designate the Department of Commerce as the lead agency for the development of Guam's aquaculture industry and to establish a one-stop permit program for potential aquaculture farmers. I have also worked closely with the Department of Commerce, specifically with Mr. Bill Fitzgerald, in applying for federal grants, introduction of additional species, the hiring of additional biologists for the Guam Aquaculture Training and Development Center, and assisting new and established farmers with issues ranging from types of pond systems to marketing strategies.

The present market and outlook for Guam's aquaculture industry have all the makings of a successful venture for anyone wishing to invest and commit his or her time in this industry. The local and commercial market for aquaculture goods have barely been tapped by local producers. As an example, those already established in the industry have no problems finding buyers. Technical advice is given with no charge, and the Department of Commerce seedstocks have been rated as one of the best in the world. Guam's seedstocks are such prime commodities that places such as Hawaii, South America, and even Israel have become our customers.

The future of Guam's aquaculture industry, however, depends not on the local or international market, nor does it depend on the availability of technical assistance or good seedstocks. The future of Guam's aquaculture industry depends on the easing of local government regulations to start a new farm.

Though the industry's consumer demands, technical assistance, and seedstock quality have improved tremendously since the 1970s, bureaucratic red tape in starting a farm has also increased. This red tape is so long and restrictive that no new commercial farm has been established since the early 1980's. In order to save and enhance this industry, the political leadership of this Territory must come together and make a decision to aggressively push for the passage of legislation needed to ease this red tape.

We must support Guam's aquaculture industry by not simply talking about this support but also by doing something about it. With the present leadership in the 23rd Legislature, I feel that we will see more pieces of legislation like the one introduced by Sen. Ben Pangelinan being introduced and passed. This prediction, however, can only happen if it is followed through by members of our community such as yourselves. If there is one thing that I have learned in my first five months as senator, it is good bills are not passed by its merits alone; they are passed because the community demands that they're passed.

So in closing, I'm appealing for your assistance in working together so that sound aquaculture and agriculture pieces of legislation gets through our political system. ❖

Aquaculture: Guam's Economic Promise

William Fitzgerald, chief planner
Department of Commerce

Aquaculture represents a part of the economy that still has great untapped potential as a major sector within Guam's economy. The aquaculture industry is relatively new to Guam. The first experimental and demonstration farm was established in 1973, followed by the first commercial operation in 1975. Since that time, the industry has grown significantly despite numerous obstacles. Today, there are over 100 acres of ponds constructed. The species currently under cultivation include tilapia, milkfish, freshwater giant prawn, marine shrimp, Chinese carp, and catfish.

The previous main limiting factor to the development of the aquaculture industry on Guam was the lack of an on-island hatchery facility. The Guam Aquaculture Development and Training Center (GADTC) fills that void and provides the needed postlarvae and fry to the commercial aquaculture farmers on a reliable and more economical basis. It also provides training and research services to help further development of the industry. Furthermore, by replacing imported stocking material with production from GADTC, the risk of introduction of diseases and parasites is minimized.

GADTC serves the Western Pacific Region and addresses production, training and research needs for aquaculture species of commercial value to Guam and the region. The emphasis is on production to meet the needs of the commercial farmers for seed stock. The operation is also expected to become self-sufficient through revenue from the sale of the hatchery's products as the industry grows.

GADTC has established itself as a world recognized aquaculture facility. It has received requests for seedstock produced at GADTC from the Middle East (Israel), North America (Arizona and Florida), Central America (Costa Rica), South America (Equador), Indian Ocean (Mauritius Islands), Asia (Taiwan and the Peoples Republic of China), Eastern Pacific (Hawaii), and Micronesia (FSM & CNMI). This is an unprecedented accomplishment for a Government of Guam-operated facility let alone an aquaculture hatchery anywhere in the world. This has been accomplished with minimal support by the Government of Guam through aggressive pursuit of grant funds to carry out the programs of GADTC and upgrade the physical plant.

ORGANIZATION OF INDUSTRY

Lead Agency

The Guam Aquaculture Development and Training Center (GADTC) is a modern aquaculture hatchery and rearing facility operated and administered under the Economic Development and Planning Division of the Guam Department of Commerce. It is intended to function as a regional center to support aquaculture development on Guam and throughout the Western Pacific. To achieve this goal, the GADTC produces aquaculture seed stock, provides training and technical assistance to farmers raising aquaculture products, and conducts applied research to facilitate commercial aquaculture development.

GADTC Mission

- ✓ The establishment of the Guam Aquaculture Development and Training Center as a focal point for aquaculture activities in production, training and research in the Western Pacific.
- ✓ Assist in the development of the commercial aquaculture industry in Guam and the region.
- ✓ Strive to implement programs that improve the efficiency and self-sufficiency of operations at GADTC and the economic viability and vitality of the aquaculture industry.

Department of Commerce (DOC) has taken the initiative to coordinate all efforts in the development of the aquaculture industry. DOC has established the Aquaculture Industry Advisory Committee and the Aquaculture Coordinating Committee. This is to assure the needs of the industry are addressed and to coordinate GovGuam's various activities to support or not impede the development of the aquaculture industry.

With the Department of Commerce, the focus of the program is on the commercial development of the aquaculture industry as a viable and contributing sector in Guam's economy. The aquaculture industry contributes to the diversification of Guam's economy which has been overly dependent on a single industry. Commerce has taken an active lead in this effort since 1982 with the "Aquaculture Development Plan for the Territory of Guam." The Department has made the commitment to this program to make it a success as part of Commerce's role in promoting economic development and diversification in Guam.

Aquaculture Industry Advisory Committee (AIAC)

To facilitate the development of the commercial sector, government has the responsibility to assure the utmost coordination of government agencies in meeting the needs identified by the private sectors. Therefore, the Director of Commerce established the Aquaculture Industry Advisory Committee (AIAC) in April 1991 to facilitate identification of the needs of the commercial aquaculture industry on Guam. These needs will serve as the basis for programs and activities developed and pursued by the government to address the development of the aquaculture industry on Guam. Appendix V lists the needs identified by the industry for 1993.

Purpose:

- ✓ To identify priority areas of the aquaculture industry by the industry on Guam. The identification of needs of the industry in a ranked order so that government resources can be focused on the most important areas to the industry.
- ✓ To coordinate the interests of the various entities within commercial aquaculture.
- ✓ To assure that government efforts best serve the private sector's needs within a framework of general public good.
- ✓ To pursue a coordinated effort in production, training, extension, marketing, and research activities that impact on aquaculture.

Members

All commercial aquaculture farmers on Guam
All entrepreneurs interested in aquaculture
Department of Commerce

Administrative Procedure

Meetings are to be held on a quarterly basis or as deemed necessary. Special meetings can be called on an ad hoc basis if need arises to address specific topics.

The Department of Commerce is the lead government agency and serves as support and coordinator of the AIAC. The Director of Commerce or his representative will serve as facilitator of AIAC. The Chairman and vice chairman will be selected by the industry representatives on an annual basis. The Chairman will serve as the AIAC representative to the Guam Aquaculture Coordinating Committee. The staff of Commerce will be available to provide support on the administration of AIAC.

Aquaculture Coordinating Committee (ACC)

To facilitate the development of the commercial sector, government has the responsibility to assure the utmost coordination of government agencies in meeting the needs of the private sectors. Therefore, the Governor established the Aquaculture Coordinating Committee (ACC) in April 1991 to facilitate government agency coordination in the development of the aquaculture industry.

Purpose:

- ✓ To address common issues of interest in the area of aquaculture and jointly pursue its promotion and lobbying of programs to facilitate the implementation of programs and the transfer of benefits to the commercial sector.
- ✓ To assure that government efforts best serve the private sector's needs within a framework of general public good.
- ✓ To pursue a coordinated effort in production, training, extension, marketing, and research activities that impact on aquaculture.
- ✓ To help facilitate coordination between agencies involved in aquaculture activities and programs, agencies that have a regulatory function that impacts on aquaculture and the commercial aquaculture sector.
- ✓ To assist in the communication flow at an interagency level and out to the commercial sector.
- ✓ To monitor progress of the industry as it relates to the Aquaculture Development Plan for the Territory of Guam.

Members

Department of Commerce
Bureau of Planning
University of Guam Marine Laboratory
University of Guam College of Agriculture and Life Sciences
Guam Community College
Department of Public Health
Department of Agriculture
Guam Environmental Protection Agency
Commercial aquaculture farmers (represented by the AIAC Chairman)
Army Corps of Engineers
USDA Natural Resource Conservation Service
Conservation districts chairmen
Chairman Agriculture Board of Commissioners
Chairman Economic Development and Agriculture Committee of the Legislature

Administrative Procedure

Meetings are to be held on a quarterly or as appropriate basis. Special meetings can be called on an ad hoc basis if need arises to address specific topics.

The Department of Commerce was appointed by the Governor as the coordinating agency in aquaculture and responsible for the administration of the Guam Aquaculture Development and Training Center. The Director of Commerce will serve as Chairman of ACC. The Vice Chairman will be rotated on an annual basis among the other agencies.

Industry Production

Aquaculture production by private farms on Guam concentrated on tilapia and milkfish over the past five years. Commercial farming of shrimp was reestablished in 1991, as a result of the initiation of postlarvae production at the Guam Aquaculture Development and Training Center (GADTC). Declines in milkfish and catfish production between 1991 and 1993 were offset by skyrocketing shrimp production totals. Marine shrimp production has increased from \$13,300 in 1991 to \$310,000 in 1993. Shrimp production is now only second to tilapia in value of production. This is the direct result of GADTC's successful implementation of the projects including those funded through PAA (Pacific Aquaculture Association).

Guam's commercial aquaculture plant is comprised of four active farms with approximately 75 acres currently under production. The Guam Aquaculture Development and Training Center (GADTC) has been successful in providing a variety of the needed postlarvae and fry to the commercial aquaculture farmers on a reliable and economical basis. It also provides training and research services to help further development of the industry. GADTC serves the Western Pacific region and addresses production, training and research needs for aquaculture species of commercial value to Guam and the region. Products of GADTC have been shipped on a regular basis to commercial farms in Hawaii, and recently to CNMI with occasional shipments to the Continental U.S. Requests for products of GADTC have been received from locations as far away as Central America, South America and Israel. The Department of Commerce is administering the hatchery's operation.

Activity in the commercial sector of aquaculture has increased during the past five years. This includes the diversification of production and the increased level of interest by entrepreneurs. This has resulted from the higher profile GADTC has taken in the past two years through media (TV, radio, and newsprint) and market promotions after the establishment of the production capability of the facility and the staff was completed. New farms have been established or are nearing establishment (clearing the permit process). There has also been an increase in "backyard" or small-scale farms.

The estimated value of Guam's commercial aquaculture production in 1994 totalled \$1.6 million. With the operation of the GADTC, the value of production from the commercial aquaculture farms on Guam is expected to exceed the value of total domestic fishery (subsistence and commercial) within a three- to four-year period, and has already exceeded the commercial sector of the domestic fishery, further emphasizing the potential role and importance of aquaculture in Guam's economy. Additionally, the island imports over \$14 million worth of fisheries products annually. Production from the aquaculture industry can replace a significant portion of these imports. Thus import substitution on a competitive basis is a major objective in Guam's aquaculture program.

Guam currently exports aquaculture products to the region and Hawaii on a regular basis. This export market offers opportunity for substantial expansion. Expansion of the local market for aquaculture products was carried out from the traditional weekend flea market to the tourism industry serving the upscale hotels and restaurants. Marine shrimp served as this initial entrant; however, since this has increased the general awareness of aquaculture products and their superior quality, some of the other aquaculture products are beginning to gain access.

Diversification of products produced has been a key area of need by the industry. This has been addressed with the marine shrimp. Mullet have developed into a commercially cultured product with the establishment of the hatchery technology at GADTC. In addition, work has been initiated

to develop grouper culture to further diversify the product mix. To further diversify the commercial opportunities in aquaculture, the examination of marine aquarium fish was initiated. The international aquarium trade is over a billion dollars annually.

Constraints to Industry Development

The major current constraint to the further development of the aquaculture industry on Guam is the regulatory process that serves as a major entry barrier to the industry for new farms. This is not unique to Guam. A report by the Joint Subcommittee on Aquaculture (June 1993) entitled "Aquaculture in the United States: Status, Opportunities, and Recommendations" identifies the regulatory constraints as the major impediment to the development of the aquaculture industry in the U.S.

The National Association of State Aquaculture Coordinators (Guam is a member) is compiling a status report on the regulatory process applied by each state. Guam has participated in this program and has provided detailed information on each of the regulatory steps involved in starting an aquaculture business on Guam.

To address this problem in Guam we have compiled a review of the regulatory process. We are also working to develop a one stop permit application process. This is being modeled after the state of Maine's one-stop application, which is the only state in the U.S. that has implemented a one stop application for aquaculture. Legislation will be drafted with the assistance of the senator's office that oversees the Guam Department of Commerce's programs. In addition, the rules and regulations that are being formulated for the new "Land Use Plan for Guam" are being modified to be more favorable to the development of aquaculture.

Recommended Action

The recommended actions to further develop the aquaculture industry on Guam are presented in two phases that should be implemented in sequence.

Phase I: One-Stop Permit and Support of GADTC

There are two key issues that need to be addressed to facilitate the development of commercial aquaculture on Guam.

- ✓ Relief from the excessively bureaucratic and disjointed permit process.
- ✓ Adequate staffing of the Guam Aquaculture Development and Training Center (GADTC) to support the industry.

One-Stop Permit

The first issue is the major current constraint to the further development of the aquaculture industry on Guam. The regulatory process serves as a major entry barrier to the industry for new farms. Interest in starting new ventures has been high, especially since the establishment of the Guam Aquaculture Development and Training Center, but no new large aquaculture farms have been started. The difficulty of obtaining permits continues to be one of the constraints that have limited the start-up of new ventures. From the perspective of the entrepreneur, the permitting process is too complex, redundant, time consuming, and costly.

The costs of permitting in money and time can be overwhelming. In effect, the permitting process can exclude many of the local farmers and entrepreneurs who have suitable land resources from participating in the development of aquaculture. Even where obtaining permits does not actually impose a constraint, the perceived complexity of the process can be very intimidating to beginning entrepreneurs.

The Governor's Forum on Aquaculture held in June 1994 focused on this issue with commitment of political leaders to resolve the issue. Unfortunately, the necessary action required subsequent to the forum has been at best progressing slowly.

Both Bill No. 1077 and 513, which have gone through the required legislative committee public hearings, are pending introduction for vote on the floor of the Legislature. Both bills have been strongly endorsed by the industry. These bills need to be acted on without further delay. The

resulting recommended action regarding one-stop permitting for aquaculture by the review committee that would be established through Bill No. 1077 needs to be implemented to realize meaningful relief from the burdensome permit process.

Adequate Staffing of GADTC

The second issue is critical to maintain the programs at GADTC and provide the necessary technical support to the establishment of new aquaculture farms, improvement of existing farm operation efficiency, carry out proactive technology development, along with product and market development programs to assure competitiveness.

GADTC is a seven-day-a-week, 24-hour operation. This requires a commensurate level of staffing for the facility. The local budgeted personnel have been initially supplemented by federal grant funds. The U.S. Department of Interior has been a major supporter of GADTC in its start-up and initial operation. However, the department has indicated that the continued operation should be fully supported by the Government of Guam.

Local budgeted staff positions total six personnel. This is an under-staffing of the minimum operational staff necessary to adequately carry out the GADTC functions by 45 percent. The minimum staffing level should be 11 full-time employees. The current success of GADTC is the direct result of extremely devoted staff members who have committed personal time beyond working hours to carry out the programs. However, this level of commitment can only be expected from even the most devoted staff for a limited period of time without resulting in physical as well as emotional burnout. Programs, projects and various basic activities of facility operation as well as industry support has suffered because of inadequate staffing. It is essential that the staffing be brought up to the minimum operational level to carry out the programs of GADTC. The budget requirement for this upgrading of staffing is elaborated below.

Without resolving these issues rapidly, the substantial accomplishments of GADTC will suffer as well as the commercial development of the industry on Guam. Numerous opportunities to expand the industry with the development of new farms by local entrepreneurs have been lost during the past three years due to the burdensome and prohibitive permit process. This is a major frustration to those involved in developing the industry and most directly the entrepreneurs who recognize opportunities afforded by aquaculture but are frustrated by the entry barriers. To prevent future lost opportunities, immediate action is essential.

Some of these pending opportunities beyond direct food production include the development of aquarium species culture, which represent a multi-billion dollar a year trade worldwide and the development of tuna baitfish culture on Guam in support of the longline fisheries. A briefing on this latter opportunity is attached.

A supplemental budget allowance is necessary for the five additional personnel delineated in the proposed budget. These new positions need to be filled expeditiously with appropriate personnel.

The projected budget cost for the additional five personnel required at GADTC is \$146,247.32. The attached table provides the budgetary details.

Phase II – Aquaculture Industry Park

Availability of land (high cost, access, infrastructure, and lot size) for development of aquaculture activities has constrained local and foreign investments in aquaculture. It is recommended that an "aquaculture industry park" be established. This would consist of suitable Government of Guam land (minimum 35 acres) for development of commercial aquaculture. Infrastructure in the form of access road, electrical power and development of water supply system should be provided. Development units would be plots of lands in half-acre increments. The land units would be leased based on a reasonable fee similar to the agriculture land lease program.

The "aquaculture industry park" would facilitate the rapid expansion of the aquaculture industry on Guam. This would greatly enhance the opportunities for residents of Guam to participate in this industry. Technical support would be provided through the Guam Aquaculture Development and Training Center

THE FUTURE

Food Fish

Aquaculture is most noted for the production of finfish and shellfish products for human consumption. With Guam's tropical climate, it provides optimal conditions for growth not only of tropical species but many warm-water species.

Aquaculture products that can be produced on Guam include fresh and salt water species of fish, shrimp, molluscs, and algae. The selection of the species cultured should be carefully considered both for their economic value, biological characteristics and potential environmental concerns.

Aquaculture food production on Guam needs to be diversified to provide a product selection to the end consumer. This also reduces the risk that may be encountered with a single or limited product mix (e.g., market constraints, price fluctuations due to external and internal competition, disease, etc.). Guam's current aquaculture products include tilapia, catfish, carp, freshwater prawns, mullet, milkfish, marine shrimp. Efforts are underway to further diversify the products to include mangrove crabs, groupers and aquarium species. Other products to address niche markets in Guam but also for export are being explored. However, these products, particularly those for export, will focus on high value and high end markets. This is due to the relatively high cost of production on Guam.

Aquarium Trade

The world ornamental fish industry has been growing steadily over the years and more and more entrepreneurs are becoming interested in the trade. Rapid development of the technology of the century is really a boon to this trade, coupled with air transport system which revolutionized this industry. Consequently more and more hatcheries, farms and traders have increased remarkably over past one decade.

The current value of world trade for ornamental fish has been estimated to be about US \$4.5 billion and the demand is growing steadily. On regional basis, the export of tropical ornamental fish is to the extent of 69 percent by value which originate from Eastern Asia and Singapore accounts for the major share of 35 percent by value followed by Hong Kong, Malaysia, Thailand, Philippines, Taiwan and Indonesia, in that order.

More than \$500 million worth of ornamental fish are imported into USA every year, which is the largest market, followed by Europe and Japan. It has been estimated that 8 percent of the estimated 86 million homes in the USA keep fish, 14 percent of the estimated 21 million homes in Britain adopted fish keeping as a hobby as did 4 percent Belgian and Italian homes. Approximately 20 percent of German homes keep aquarium fish. Fish keeping is also popular in Japan, China, Australia, South Africa and other countries. About 85 percent of the market for ornamental fishes is of freshwater origin; the rest is for marine ornamental fishes, which are high value items, and invertebrates and brackish water fishes. The growing popularity of fish keeping is reflected in the ubiquitous aquaria that feature as an integral part of modern interior decoration. The demand for good quality tropical fishes far exceeds the supply. This points to the fact that aquarium fishes are of substantial commercial value in the export trade worldwide.

The culture of marine aquarium species could potentially benefit island members of the South Pacific Commission (SPC) region and address issues under SPC's work program of marine resource development, fisheries development and economic development. The production of a high value renewable resource product which utilizes indigenous species offers an excellent opportunity to develop an export product of the island countries of the South Pacific Commission. The international aquarium trade represents a multi-billion dollar industry. The SPC country members have a potential competitive advantage in this industry for tropical marine species. The use of aquaculture procedures removes the potential detrimental environmental consequences of collecting aquarium species from the wild while developing the industry on the basis of a renewable resource.

In the last two decades, efforts have been undertaken to develop culture methods for various species of marine ornamental fishes. A few species, mainly *Amphiprion sp.* (i.e., clownfish) and the neon goby, *Gobiosoma oceanops* have been cultured commercially for several years. These species were chosen for commercial development due to their popularity in the aquarium trade and their ease of culture. However, these species have a relatively low commercial value compared to many other species. For example, recent wholesale prices for tank raised clownfish and neon gobies were approximately \$2.50 to \$3.00 per fish (producers receive approximately \$1.25 to \$1.75 per fish), whereas the wholesale price of several other species can range from \$10 to \$25 per fish. Higher value species may be profitably cultured in lower quantities, decreasing the risk of over saturating the market. In addition, experience with commercial aquaculture of freshwater ornamental fish indicates that diversification of species is often important for effective marketing.

The aquarium industry trade in the United States alone represents expenditures of \$240 million per year. Worldwide trade in the aquarium industry is estimated at \$4 billion. Live rock has become a significant high value commodity in the marine aquarium trade in recent years reaching a million-dollar enterprise in a relatively short period. It is used as the basic component in the mini-reef aquarium tanks (hobbyists and commercial aquariums). The sale price of the rock depends on the type of macro-life growing on it. Live rock consists of chunks of dead coral and non-coral limestone permeated with bacteria and encrusted with an array of algae, mainly coralline algae. In addition, numerous other organisms are often included as part of the biological community on live rock. These include tube worms, tunicates, anemones, sponges, brittle stars, sea urchins, crabs, shrimp, molluscs, sea fans, and corals.

Live rock serves two main roles in aquariums: first for its natural beauty, and second as a chemical and biological filter. The bacteria population comprised of bacteria on the surface (aerobic) and within the porous interior (anaerobic) of the rock are capable of nitrification and denitrification. A properly designed aquarium with live rock can eliminate the need for other filtration systems (e.g., wet/dry filter).

The culture of ornamental tropical fish and plants is a clean industry utilizing renewable resources with little environmental risk. Ornamental aquaculture produces a very high value, low biomass commodity, and for these reasons, the cost of importing feed and exporting product, the water requirements would be relatively low, which would reduce future use conflicts. Water discharge from production systems would minimally impact the environment, and production systems would lend themselves to biological filtration.

The livestock segment of the aquarium industry is currently valued at \$1.4 billion annually, and in 1992, the U.S. imported \$41 million in ornamental fish from foreign sources. Primary suppliers included Singapore, Thailand, Indonesia, Hong Kong and the Philippines. The aquarium fish market has increased at an average annual rate of 10 to 15 percent over the last decade. Exports of ornamental fish from the U.S. 1992 totaled \$16.5 million, and increase of 29 percent over a year earlier. Almost half of these exports went to Japan, Hong Kong, and Taiwan. Over 25 percent of the exported fish supplied markets in Canada.

Excellent models for this industry development can be observed in Florida, Israel and South Africa, which have all obtained dramatic expansion in the ornamental production sector over the last decade. Most successful aquaculture industries have developed utilizing resources which impart a production advantage to a particular area. This is true in the case of the trout industry in Idaho with their plentiful clean water resources. The catfish industry in Mississippi has similarly capitalized on inexpensive and relatively unproductive farm land, but land which has a good clay content and groundwater resources favorable to aquaculture. In Florida, there is a substantial industry growing ornamental fish and plants which in 1992 had net sales exceeding \$40 million. This domestic industry has developed utilizing primary resources of available water for fish production, and air freight infrastructure to access U.S. and foreign markets.

Potential for Aquaculture of Bait on Guam

Tuna longline vessels prefer to use live milkfish as bait because it is significantly more effective

than other baits. Milkfish have been shown to be three to five times more effective in catch rate than dead bait (Bartram personal communication, 1994). In addition, of the live baits the milkfish is preferred since it tolerates handling and long term holding in bait wells. Milkfish bait tolerate the depths the longlines are set at and usually remain alive even when the longline is retrieved. This significantly improved effectiveness in the use of milkfish translates into a substantial economic benefit to the vessel since catch rate is improved, which means either the catch per trip is increased or trips can be shortened to reach the same catch target. For example, a line deployed with 1,000 hooks could result in a catch of 30 tuna with an average value of \$200/fish using conventional bait such as squid. By utilizing live milkfish as bait, this could increase the catch for the same deployment of a 1,000 hook longline of 90 to 150 tuna. This represents an addition in value of \$12,000 to \$24,000 per set. This one set would more than offset the entire cost of the live milkfish bait for the entire trip (representing multiple sets) of approximately \$4,000.

To avoid the down time in fishing required for travel to Taiwan to purchase the bait which requires one week travel time and two weeks in port to get loaded, longline operations prefer to purchase the bait on Guam. Traditionally, Taiwan vessels departing Taiwan for the fishing grounds in the Western Pacific would load enough live milkfish bait for approximately two fishing trips. Thereafter, the less effective dead bait would be used.

A Guam-based corporation has entered into an exclusive contract agreement with a Taiwanese longline fleet, Enterprises, to provide the bait starting in March 1995. A three- to five-year contract would be offered by the Taiwanese company to provide the bait. The company has obtained a lease on a 14-acre site to establish a farm. A prefab concrete pond design is intended to be utilized for the ponds. The scheduled first delivery date to the fleet of bait is March 1995. A bait-carrier vessel from the Philippines may be used to meet this first delivery obligation and allow time for the farm construction and initial operation.

One of the current largest aquaculture farms on Guam has entered into an agreement with one of the tuna transshipment agents to produce milkfish for bait. The farm started the transition in production at the beginning of 1995. This will represent 35 acres of ponds for the tuna bait market.

All of the transshipping agents are trying to make arrangements to be able to provide the live milkfish bait to the tuna longline vessels they service to remain competitive with other agents that have secured a source. These companies are looking at bringing in the juveniles which would be held for a short period before distribution to the vessels. They are also considering developing aquaculture farms on Guam to produce the bait. The largest longline fleet in the region, Ting Hong, has also expressed interest in establishing a bait aquaculture farm on Guam to supply its fleet.

Market

A Taiwan fishing company wants to purchase juvenile milkfish (about 6 inches long) live bait. Its requirement is 8,000 - 10,000 pieces per vessel per trip. Each vessel makes two to three trips per month. The number of vessels the company intends to have based out of Guam ranges from 30 to 200, depending on the season. Table 1 provides the vessel schedule.

The cost of the live milkfish bait in Taiwan is \$.148/piece during the low season and \$.37/piece during the peak season. However, the price is reported to reach \$.50/piece or higher in Taiwan (Kuo & Hwang, personal communication - 10/94). There are about six pieces per pound; therefore, the price by weight is \$.89 to \$2.22 per pound. It would be expected that a premium price would be paid for bait in Guam since obtaining bait in Guam would save three to four weeks in fishing time plus ship operation expense. In addition, this lost fishing time represents lost revenue from potential catch.

The annual demand based on the average number of monthly port of calls is 1.9 million pieces per month or 22,800,000 pieces per year at a price of \$2.22 per pound, this would be worth \$8,436,000 a year.

TABLE 1. Tuna Fleet Monthly Bait Demand

	Vessels based in Guam	Ports of Call	Approx. Bait demand (1000 pieces)
Jan	30	60	600
Feb	30	60	600
Mar	30	60	600
Ap	50	100	1,000
May	100	200	2,000
June	150	300	3,000
July	150	300	3,000
Aug	150	300	3,000
Sept	200	400	4,000
Oct	100	200	2,000
Nov	100	200	2,000
Dec	50	100	1,000
Total	1,140	2,280	22,800
Average	95	190	1,900

Production

To produce the quantity needed for the tuna longline fishery will require a substantial commitment of pond area and resources. Table 2 presents different scenarios.

Tuna Transshipment Industry

The foreign longline fishery on Guam grew at a rapid pace from five to eight vessels in late 1986. At the end of 1993, 270 individual vessels made more than 1,000 port calls to the island. The number of port calls increased in 1994 to 236 vessels with 687 port calls for just the first seven months of 1994. Port-of-call data at the Department of Commerce is available back to 1990. For the first time, in 1993 statistics posted a majority of port calls made by Taiwanese vessels (569) in comparison with calls by Japanese vessels (399).

The longline vessels, which range in size from 19 to 59 tons, reportedly fish mainly in the waters of the Federated States of Micronesia (FSM) with a growing percentage in international waters. The catch is off-loaded on Guam for air-transshipment to Japan for the sashimi markets, with the exception of the portion of the catch that does not meet the quality requirements. This latter portion of the catch is termed rejected fish.

Tuna rejected for the sashimi market is presently handled in three primary ways: purchased by a reefer vessel, which stores the tuna for pickup by a mother vessel for the Korean tuna market; or frozen for container transshipment to canneries. A third use of the rejected fish is by a private Guam-based processor that processes rejected tuna into jerky, loins and other value added products. Since 1991, Department of Commerce's figures show that roughly 13 percent of the tuna off-loaded is rejected from transshipment to the sashimi market.

The longline transshipment fishery on Guam consists mainly of Japanese and Taiwanese vessels. The vessels call at the Guam Commercial Port where the catch is contracted to agents who handle the dockside off-loading, inspection, weighing, boxing and shipping of the fish. There are

**TABLE 2. Production Scenarios
(80 percent survival rate, four crops/year)**

Quantity Needed (Million Pieces/Year)	Stocking Density (Pieces/sq m)	Area Needed (Hectares)
20	20	31.25
20	40	15.63
20	60	10.42
20	80	8.81
20	100	6.25
20	120	5.21
20	150	4.17
20	200	3.13
25	20	39.06
25	40	19.53
25	60	13.02
25	80	9.77
25	100	7.81
25	120	6.51
25	150	5.21
25	200	3.91

Shaded areas are most likely scenarios.

Basic culture parameters obtained from Taiwan

- ✓ Culture area needed: approximately 1-1.5 ha/1,000,000 pieces/year
- ✓ Stocking density: 150,000-300,000/ha (15-30/m²)
- ✓ Growth rate at given stocking densities: from 2 cm fry to 15 cm takes 45-90 days
- ✓ Can you slow the growth down for off season stocking: Yes
- ✓ Survival: 80-95%
- ✓ Price per fry (reported to be \$.035/fry but in large numbers \$.005/fry Philippines) - \$400/10,000 pieces or \$.04/piece Taiwan
- ✓ Availability of fry in quantity needed: Yes
- ✓ Months available: May-Oct

currently seven agents who handle this activity. The role of the vessel agent is to organize and/or facilitate procedures involving: port entry/departure; customs and immigrations; fuel, water and ship's chandlery; payments for port call services; and distribution of R&R money.

Numerous other primary and secondary support services have evolved as a direct result of the growth and changes of the longline tuna transshipment industry. The culture of bait fish is one that has significant potential of expanding the aquaculture industry and adding to the economy as a whole.

The catch consists mainly of yellowfin and bigeye tuna. An estimated 3 - 5 percent of the total catch consists of billfish, mostly marlin. Billfish have been included in the shipments to Japan. Prior

to this market change, they were either sold locally or discarded. The price for transshipped fish varies according to the quality. The air freight cost to Japan is about \$1.25 per kg. The primary destination of the tuna upon transshipment is Narita since refrigerated trucking is available to all parts of Japan. Other market distribution areas in Japan are Osaka and Nagoya. In addition to Japan, there are some small marketing opportunities for fresh tuna in Hawaii and the U.S. mainland.

For 1993, a total of 7,104 metric tons of fish were off-loaded from longline vessels and were transshipped from Guam, as shown in Table 4. Of this amount, 52 percent was bigeye tuna, and 44 percent was yellowfin. This reflects a 32 increase over the 1992 transshipment total of 5,390 metric tons. These totals, however, are still well below the 1989 peak year estimate of 15,000 metric tons.

The fluctuations in the Guam based longline tuna industry after 1990 reflect growing pressure from the Federated States of Micronesia in tying the issuance of fishing permits in its water to off-loading the catch from their ports. The support infrastructure and air cargo infrastructure has improved during this period in the FSM. This has resulted in a decrease in the number of vessels transshipping from Guam. This is exemplified by the decline in port of calls from 1,450 in 1990 to 846 in 1992 (the lowest point).

Prior to 1991, most foreign longline vessels licensed to fish in the EEZ (Exclusive Economic Zone) of the FSM off-loaded their catches in ports other than those in the FSM and thus negated the possibilities for collecting relevant data. Recently, the Micronesian Maritime Authority (MMA) has shifted the licensing priorities to encourage the basing of foreign longliners in FSM ports. As a result, the number of longline vessels now off-loading their catches in FSM ports has increased dramatically. In 1992, a total of 670 port-of-calls were made in the FSM while in 1993 the number of port calls made more than doubled with 1,432 landings recorded. This coincides with the decline in the number of port calls made to Guam during this time period.

TABLE 3. Potential Bait Demand/Value Based on Port of Calls

Year	Port of Calls	Vessels Based in Guam	Potential Bait Demand * (in millions)	Potential Value ^b (in \$1,000,000)
1986	195	—	1.95	\$0.975
1987	207	—	2.07	\$1.035
1988	728	—	7.28	\$3.640
1989	1,055	—	10.55	\$5.275
1990	1,450	328	14.50	\$7.250
1991	1,078	233	10.08	\$5.036
1992	846	224	8.46	\$4.230
1993	1,089	270	10.09	\$5.045
1994	1,509	348	15.09	\$7.545

* Based on 10,000 pieces/trip

^b Based on \$.50/piece

1986-1989 estimated port of calls of longline vessels at 78% (based on post-1989 percentage) of total number of fishing vessel port of calls (inclusive of other types).

**TABLE 4. Annual Longline Transshipment Volume
1986 thru 1994: Metric Tons**

Year	Total Transshipment	% Change from Previous Year
1986	5,364	—
1987	3,116	- 42
1988	6,772	+ 117
1989	15,000	+ 122
1990	12,729	- 15
1991	9,587	- 25
1992	5,391	- 43
1993	7,104	+ 32
1994	8,962	+ 26

Totals for 1989 and 1992 are estimates.

Source: Guam Department of Commerce and Port Authority of Guam

However, Guam has a number of competitive advantages over the other ports of the region. This includes lower fuel cost, along with better and greater services available (e.g., rest and recreation facilities, medical services, provisioning, equipment repair, ship repair, etc.). The addition of baitfish availability would add a very significant competitive advantage that should draw additional vessels to base in Guam. Furthermore, bilateral negotiations are underway between Guam and FSM to change the restrictive FSM fisheries policy regarding port off-loading. If this fails, it is expected to result in the U.S. Department of Interior intervening to relieve this constraint to vessels porting in Guam that fish in FSM.

Benefits

Baitfish production expands the potential economic opportunities for the development of the aquaculture industry. It further diversifies the market opportunities. A synergistic benefit would be realized by the Guam based tuna transshipment industry. The availability of a cost effective source of baitfish on Guam provides a significant competitive advantage to the Guam tuna transshipment industry. Similarly, the successful culture of baitfish on Guam would stimulate expanded demand with additional fleets sourcing bait in Guam.

Taiwanese vessels usually spend eight to nine months in the fishing grounds before returning home to Taiwan. It would be expected that returning vessels to the fishing grounds would bring live milkfish bait with them that would be adequate for one to two months of fishing. This would reduce the overall demand by that proportion of the bait demand for that percentage of the total vessel fishing months.

Conclusion

Based on the best information available, it appears that the most likely production scenario would require approximately 20-25 ha of ponds to produce 20 million pieces of bait per year. This could consist of new ponds, the conversion of existing ponds to bait production or a combination of the two. However, it is recommended that the bait production capacity be phased so not to produce an oversupply. In addition, the construction of new ponds should be designed to be easily transferred to use in the culture of other commercial aquaculture products in case the bait demand declines.

Specific Pathogen-Free (High Quality) Seedstock Center

The establishment of a specific pathogen-free (SPF) marine shrimp broodstock population at GADTC for the production of postlarvae to supply commercial aquaculture ponds in Guam and eventually the islands of the Western Pacific region is critical to the responsible development of an aquaculture industry. There is a need to establish specific pathogen-free stocks of commercially important species of marine shrimp. This is not only an important step in the development of marine shrimp culture on Guam, but can play an important regional role in providing a backup or alternative source of SPF penaeids.

Since GADTC is intended to serve as a regional facility in supplying fry and postlarvae for commercial aquaculture, it is highly desirable to establish SPF broodstock to minimize the potential transmission of pathogens in the region.

It is increasingly apparent that stable intensive culture of marine shrimp will be dependent on availability of shrimp stocks free of certain obligate microbial pathogens of shrimp. The establishment of reproducing stocks of aquaculturally important penaeid shrimp should be done with the goal that these will be SPF populations. The outbreak of shrimp disease can have a major negative economic impact on commercial aquaculture. For example, the epidemic spread of marine shrimp disease pathogens has had a catastrophic impact on cultured marine shrimp production in Taiwan in recent years. The *Penaeus monodon* crop failure in Taiwan, which started in 1988, resulted in an estimated loss of 80 percent or more of the normal expected production (Sheeks, 1989). This had disastrous economic impacts which rippled from the producers through the industry both upstream (private hatcheries) and downstream (marketing agents).

Problems with disease in commercial shrimp culture is a worldwide problem. The pathogens which result in the various diseases evident in cultured shrimp are often not a problem in the wild populations; however, when cultured under the increased stressed conditions of commercial production, these diseases become an economic important factor. Bacteria and viruses that have been identified as shrimp pathogens are spreading and new diseases are continually being identified (Kuljis, 1992). These diseases have increased operating costs resulting in reduced profit or in some cases loss of shrimp farms (e.g., Taiwan). It has been demonstrated in Hawaii and in the U.S. Mainland that specific pathogen-free stocks of *Penaeus vannamei* have improved production performance when compared to stocks contaminated with the IHNV virus (Wyban, 1992; Carpenter, 1992).

Guam's natural geographic isolation provides a safeguard for keeping out unwanted biological agents. Guam initiated a moratorium on the importation of live penaeid shrimps in 1988, unless accompanied by a valid certification of being SPF. This is to prevent the possible introduction and spread of marine shrimp pathogens in the commercial production of shrimp. In addition, Guam does not have indigenous species of penaeids, thereby minimizing the possible transmission of pathogens to introduced SPF populations. The establishment of reproducing stocks of aquaculturally important penaeid shrimp in Guam should be done with the goal that these stocks will be SPF populations.

At the initiation of the project, the obligate pathogen status of *P. monodon* populations in Palau was unknown. It was possible that the wild stocks of *P. monodon* in this geographical region were free of several obligate pathogens that have been identified in cultured populations of this species in many areas of Asia.

The project examined the indigenous populations of penaeid shrimp in Palau to determine if specific pathogens were present in the populations. If the populations proved to be specific pathogen-free (SPF), the intention was to establish broodstock of the desirable species at GADTC to supply SPF seedstock to commercial farms in Guam and the region. *Penaeus monodon* was the primary target species. The use of an indigenous species in the region eliminates the potential problems of introducing an exotic penaeid species to islands with penaeid populations.

Based on preliminary work by the Hawaii Institute of Marine Biology under a CTSA grant on the assessment of business opportunities to supply SPF penaeid shrimp stock, there is a potentially large and lucrative market for SPF *P. monodon* as well as other species for commercial culture

(Kuljis, 1992). This market consists mainly of Central and South America along with the Asian countries of China, Taiwan, Philippines, Thailand and Indonesia. A business plan under the CTSA grant is being prepared to evaluate the economic feasibility of constructing and operating a hatchery facility in Hawaii and in Guam to serve these markets.

GADTC could potentially provide SPF seedstock to these markets. GADTC currently ships SPF seedstock of *P. stylirostris* to Florida, Arizona, and Hawaii. Requests have also been made from Central America for GADTC SPF stock. Therefore, the pursuit and establishment of a SPF population of penaeids can potentially provide significant economic returns as well as facilitating the development of commercial grow-out culture of penaeids in Guam and the region.

Biomedical Research Animal Production

Examples of some applications of aquatic species in bioassays include the following:

✓ Research Triangle Institute in Research Triangle Park, N.C. (Business Week, Oct. 18, 1993) is helping identify chemicals that could hurt mammals, including people. Randolph Sleet, head of the institute's comparative and environmental toxicology lab, says brine shrimp could be used to reduce the number of animals required to screen potential toxins. And the price is right: \$4 for a 6-inch tube filled with one million embryos.

✓ Freshly hatched brine shrimp larvae are grown in the blood serum of animals that have been exposed to a toxin. Over the next 48 hours, the larvae are observed for swelling, missing body segments, and death. If the toxin affects the way shrimp genes build proteins, it probably will also affect the way that genes in higher organisms build them. Sleet has used the technique to explore the toxicity of heavy metals such as cadmium and mercury, and is now exploring 2-methoxyethanol, a solvent used in making semiconductor chips.

Natural Products used in Drugs (e.g., Sea Cucumbers, Algae, Tunicates.)

Sponges and soft corals in particular have been shown to produce compounds that inhibit the release of an enzyme which initiates a cascade of reactions leading to pain and inflammation. In the December 1992 issue of the Journal of Natural Products, Drs. Barbara C.M. Potts and D. John Faulkner of UCSD's Scripps Institution of Oceanography and Robert S. Jacobs of UC Santa Barbara review Ca Phospholipase A2 Inhibitors from Marine Organisms.

Stock Enhancement Programs (Restocking Over-Fished Reefs)

Stock enhancement is a management strategy utilizing the products of aquaculture to replenish depleted natural stocks. Some of the more familiar efforts in stock enhancement include salmon and trout species with state and national hatcheries designed for that sole purpose.

The application of stock enhancement can be done in Guam with some species which have been drastically reduced by fishing pressures. An example of this would be the giant clam species. A limited effort was made by the Aquatic and Wildlife Resources Division of the Guam Department of Agriculture. These were giant clams brought in from the hatchery in Palau. A program was proposed by the Department of Commerce to supply the restocking material through the Guam Aquaculture Development and Training Center to Department of Agriculture for the restocking of the giant clams. However, Department of Agriculture decided not to pursue the project. GADTC has worked through the Sea Grant program to provide seedstock of trochus for a restocking project in Pohnpei.

Species generally impacted the most by fishing pressure to the point of large decline in stocks are those that are sedentary on the reef flat or within diving range (e.g., giant clams and trochus) and those species associated with the bottom habitats (e.g., groupers). The latter has potential of being technically feasible in the future. Restocking programs in Hawaii currently focus on mullet (*Mugil cephalus*) and moi (*Polydactylus sexfilis*). These are both species that are produced by aquaculture and released in to the wild as well as being cultured commercially.

A stock enhancement program must evaluate a number of criteria including the technical aspect, economics, and biological parameters (e.g., genetic diversity and disease exposure) before being implemented.

Biotechnology Industry Potential for Guam

Biotechnology is the application of scientific and engineering principles to provide goods and services through mediation of biological agents. Biotechnology is broadly defined to include any technique that uses living organisms (or parts of organisms) to make or modify products, to improve plants or animals, or to develop microorganism for specific use. The development of materials that mimic molecular structures or functions of living organisms (e.g., DNA technology) is also included.

Biotechnology consists of a number of subareas of specialized development. These include a wide spectrum of fields such as medical, chemical, waste management, aquaculture, agriculture, veterinary medicine, toxicology along with a wide range of products including pharmacological, immunological, diagnostic, energy, marine natural products produced through biotechnology. Exclusive of agriculture, application of biotechnology in sewage treatment and water purification now comprises the largest sector in volume. Production of beer and spirits, cheese and other dairy products, baker's yeast, organic acids, and antibiotics follow in order of decreasing value. These traditional applications of biotechnology, which are based primarily on use of terrestrial organisms, are enormously important to the economy as well as human health and nutrition.

Current Status

An area on the east coast of Guam, from Fadian Point (Guam Aquaculture Development and Training Center) to Tagachan Point (aquarium site), is being proposed to be a special hybrid zone of Intensity District 2M in the Land Use Plan for Guam now being prepared. The designation 2M would include activities associated with the biotechnology industry. Marinas, livestock, golf courses and incompatible facilities would be eliminated from the Intensity District 2 list; otherwise, it would be similar to Intensity District 2 with the addition of biotechnology, aquarium and related activities. The activities identified with the zone would enhance the natural comparative advantages Guam has to support this industry and preserve them into the future.

Biotechnology is a growing industry worldwide, and analysts are predicting that it will have a profound impact on health care, agriculture, energy, and environmental management. By the year 2000, the biotechnology industry is projected to have sales reaching \$50 billion in the United States. Development and production of biotechnological products will create thousands of new jobs and promote renewed economic growth, and has the potential of helping address agricultural, environmental, and health concerns in developing countries. Developments in modern molecular biology indicate that biotechnology is still in an emerging phase. Some authorities expect high technology, especially biotechnology, to be a primary basis of America's economic development and strength in the 21st century.

The United States is the world leader in research expertise in marine biotechnology. However, its leadership faces stiff competition from other countries moving ahead with strong national investment and planning in this field. Focused research in marine biotechnology in concert with commercial development offers the promise of economic and social opportunities. It will lead to new industries and new jobs. It will help upgrade and advance higher education to meet United States needs in an increasingly technical and competitive world. It will assist in reversing the U.S. trade deficit, which in seafood alone is \$2.4 billion a year, second only to petroleum. It will lead to new international markets and overall economic development.

Federal support to marine biotechnology includes programs from the following agencies.

- ✓ Food and Drug Administration
- ✓ National Institutes of Health
- ✓ National Oceanographic and Atmospheric Administration
- ✓ Office of Naval Research
- ✓ Department of Energy
- ✓ Department of Interior
- ✓ Environmental Protection Agency

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- ✓ National Science Foundation
 - ✓ U.S. Department of Agriculture

A recent report (June 1993) from the Office of Science and Technology Policy Committee on Life Sciences and Health (Office of the President) identifies the significant potential for biotechnology and the commitment of the Federal Biotechnology Research Initiative. This initiative is intended to sustain and extend U.S. leadership in biotechnology research for the 21st century in order to enhance the quality of life for all Americans and to spur the growth of this important component of a healthy U.S. economy.

There is a rich potential for exploiting the biochemical capabilities of marine organisms to provide models for new classes of pharmaceuticals, polymers, other chemical products, and new industrial processes as well as vaccines, diagnostic and analytical reagents, and genetically altered organisms for aquaculture. Marine invertebrates have been shown to be extraordinarily good models for biomedical research. As an example, soft shell clams develop leukemias, the etiology of which is still unknown. However, a monoclonal antibody which identifies a leukemia-cell specific protein, has enabled researchers to study the epidemiology of this disease. The development of gene probes and analysis of conserved amino acid sequences will resolve major questions about leukemia in general.

The oceans of the world represent a vast source of new foods, pharmaceuticals, minerals, and energy. Marine biotechnology is a major subsector that covers a wide range of activities. This includes the use of marine organisms as test animals (e.g., squid and *Artemia*) for medical and environmental products. Other activities will address the following areas:

- ✓ Open new avenues for monitoring health and treating disease,
- ✓ Provide innovative techniques to restore and protect aquatic ecosystems,
- ✓ Increase the food supply through aquaculture,
- ✓ Enhance seafood safety and quality,
- ✓ Develop new types and sources of industrial materials and processes,
- ✓ Expand knowledge of biological and geochemical processes in the world's oceans,
- ✓ Molecular genetics,
- ✓ Bio-organic chemistry and pharmacology,
- ✓ Immunobiology and pathology,
- ✓ Endocrinology and development and reproductive biology,
- ✓ Environmental and evolutionary biology,
- ✓ Biofilms and corrosion,
- ✓ Biomaterials and bioprocessing,
- ✓ Ocean Thermal Energy Conversion.

Examples of commercial applications include Martek Corporation, a company now using algae for the production of a class of fluorescent proteins called phycobiliproteins which have applications in biomedical research and clinical diagnostics. Triangle Institute is using brine shrimp to identify toxins to mammals, including humans. A research program based in Japan is currently looking at tropical marine organisms for application in marine biotechnology. The collection of marine organisms is being carried out in Micronesia.

Guam is already involved in some of the activities associated with the field of biotechnology. These include mainly aquaculture which has a base of support in the Department of Commerce's GADTC along with the commercial farms in Guam. In addition, research on various subjects that are considered biotechnology is carried out at the University of Guam Marine Laboratory. Both facilities are within the proposed special zone. A proposed aquarium is also within the proposed zone. All three facilities could serve as pivotal points for marine biotechnological activities and compliment the development of a marine biotechnology industry on Guam that is concentrated within the proposed zone.

Potential

Biotechnology and more specifically marine biotechnology has the potential of developing as an industry on Guam. Guam has comparative advantages in this particular field of biotechnology,

such as its tropical year-round climate, pristine environment, marine species diversity, and business advantages associated with a United States territory (e.g., legal structure, patent laws, etc.).

Marine biotechnology has the potential to develop rapidly and to provide major economic returns. We must actively plan for partnerships with industry and commercial enterprise and facilitate efficient technology transfer. Federal programs are being focused on the field of marine biotechnology in the United States to exploit the unlimited possibilities that aquatic organisms have for protecting public health, for restoring degraded ecosystems, for improving seafood production and safety and for developing an array of new products.

The importance of marine biotechnology is recognized internationally by the leading industrial nations of the world. Germany has established a new Institute of Marine Microbiology. Through its Bioindustry Development Center, the Japanese Ministry of International Trade and Industry, in cooperation with academic scientists and about two dozen industrial firms, led the establishment of the Marine Biotechnology Institute. This action is based on the premise that marine biotechnology is the "greatest remaining technological and industrial frontier." MITI's objective is for Japan to have the first full-scale marine biotechnology research and development base in the world.

U.S. federally supported projects in marine biotechnology has resulted in 170 U.S. patents since 1983. Research includes ways to prevent or reduce biofouling and biocorrosion, to treat hazardous wastes through bioprocessing and bioremediation, to use controlled aquatic environments to grow food, and to define biological processes and relationships with molecular techniques. Examples of areas of research include the following:

- ✓ Identified novel anti-inflammatory, antitumor, and anti-AIDS substances under development as potential drugs.
- ✓ Isolated a variety of human hormones and pre-hormones from marine algae as well as enzymes involved in their biosynthesis that are being used to produce active analogues in the laboratory.
- ✓ Developed triploid oysters that are a primary basis for revitalizing the oyster industry on the West Coast.
- ✓ Demonstrated the feasibility of using proteins from mollusk shells as models in developing biodegradable polymers and surface cleaning agents for industry.
- ✓ Developed recombinant DNA technology for generic improvement of certain food fish.

It is critical to consider biotechnology as an industry that Guam may diversify into as an expansion to the economic base. It would provide high salaried employment opportunities to the residents of Guam while utilizing a renewable resource for sustainable development. Setting aside an area designated for this type of development would show the foresight in pursuing this industry. The land use planning stage is an appropriate starting point in planning for the future. The proactive solicitation of specific types of activities within biotechnology most suited to Guam's comparative advantages should be pursued to bring the industry to Guam. This would include foreign- and U.S.-based companies.

ACTIVITIES

Import Substitution

Import substitution with aquaculture products grown on Guam offers a number of economic benefits. However, in an effort to develop the industry, tariffs or other forms of taxation should not be imposed on the imported products since this results in the development of inefficiencies within the industry as is the case with restrictions in free trade in all industries in general. The aquaculture products on Guam must be competitive with the imported products. This may be on price or quality or both criteria.

Guam imports over \$14 million of seafood on an annual basis. A significant portion of this can be replaced by locally produced aquaculture products. An example of this is the tilapia which has

replaced the majority of the imports for this species. Other species that have had a degree of success on replacing imports are the milkfish and marine shrimp.

Export

The export of Guam's aquaculture products is currently being done, but to a very limited extent. This is an area that is essentially untapped and offers exceptional opportunities to further support the growth of the industry.

Current exports mainly consist of seedstock from the GADTC. However, commercial farms have exported their products to Nauru and the CNMI in the past.

The main export markets for grow-out products will be Japan, Hong Kong, and Taiwan. Within Micronesia, CNMI offers market opportunities until they develop their aquaculture industry. Niche markets will be the target of the Guam products. This will consist of focusing on high value and high quality products for specialized markets. Guam would not be able to compete on volume sales of products that have a wide base of suppliers.

The export products, particularly to the Asian markets, will have to be high value products. An example of this market was recently (May 1995) identified by a Guam investor. The market is Japan and the product is marine shrimp in the amount of approximately 30,000 lbs per week. This one market outlet would represent an annual export value of \$3.5 million. This represents only one market outlet in Japan plus there are similar market opportunities in Hong Kong and Taiwan.

Intensive Systems with Environmental Controls Incorporated in Design

The development of coastal aquaculture on Guam is constrained by the limited land available for brackish water and marine ponds. The high value placed on most of the coastal areas for competitive uses such as tourism facilities and residential housing, increases the total cost of production. In addition, a large portion of the coastal area is held by the military which further limits the coastal land available. To utilize to a fuller extent these limited coastal resources, application of intensive aquaculture methods is needed.

Intensive aquaculture is a means of addressing the constraint of limited land resources which occurs in small islands and other land limited areas. In excess of 600 acres of land suitable for aquaculture development on Guam has been identified; however, only a small portion is suitable for coastal marine aquaculture due to physical constraints and competing uses of the land. To further develop and diversify the industry, there is a need for improved utilization of resources (capital, land and labor), pond management technology and pond ecology. Such methods would address controlling the system's input to maximize the output. This would include improved pond carrying capacity, survival and production, along with the systematic application of financial and economic decision procedures.

The application of aquaculture technology to the treatment of effluent to reduce the potential environmental impact will be a necessary component of the farm design. Maintaining the environmental integrity is critical to the aquaculture operation; therefore, it is in the interest of the aquaculturists to minimize adverse impacts to the environment. However, there needs to be a reasonable balance between the environmental and economic issues in developing a sustainable future for aquaculture as part of the economy. ❖

Historical Perspectives on Aquaculture

Rufo J. Lujan, chief

Division of Aquatic and Wildlife Resources, Guam Department of Agriculture

Let me begin my presentation by thanking the sponsors of the Guam Farm Bill Workshop for the opportunity to address you today. If my presentation sounds negative, it is a deliberate attempt on my part at trying to present a balanced view for anyone thinking of entering into the aquaculture industry on Guam.

Too often, potential investors are painted a rosy picture on investment opportunities with problems and pitfalls being just glossed over.

The theme for the panel that I am assigned to is "Aquaculture – Present and Future." But, it would be imprudent for us not to look at the *past* (emphasis added). That great man Winston Churchill said that "The farther backward you can look, the farther forward you are likely to see." Therefore, to see whether there is any future for aquaculture on Guam, I will review the past.

The Department of Agriculture's Division of Aquatic and Wildlife Resources (DAWR) initiated investigations on aquaculture in 1973. The site chosen was on private property near the mouth of the Talofofu River. The species introduced were the Japanese eel *Anguilla japonica*, the Malaysian giant prawn *Macrobrachium rosenbergii*, several species of carp and milkfish *Chanos chanos*. Other species were introduced and (issues) examined by the DAWR over the course of the investigation included: high cost of feed; lack of trained personnel; high labor cost; availability of cultured stock; etc. But, despite the problems, several persons became interested in aquaculture that, at one time, there were as many as six aquaculture farms on island. However, the six aquaculture farms were the maximum number of farms since then.

The question that should be asked then is why has not aquaculture succeeded as a viable (industry), albeit with some problems? There is no one simple answer or solution. Rather, it is a combination of factors which are almost totally economic in nature. Let me analyze these factors, which I will mention in no particular order of importance.

Land is a scarce commodity and more so on a small island. The price of land on Guam is high, regardless of location and zoning. Lands suitable for aquaculture must be close to suitable and available water supply.

Accessibility from and proximity to an improved roadway is an important consideration in selecting a site for any development, including aquaculture. Constructing and maintaining even a temporary road can be very expensive.

Labor cost on Guam is high, compared to countries in Asia and Micronesia. It is doubtful whether there are skilled workers in aquaculture in our labor force so that an aquaculture farmer would have to hire unskilled workers and then train them. Usually, turnover of workers in the agricultural industry on Guam is high.

I mentioned the need for water earlier. Pumping water from a well or stream is regulated. Water level or flow in some of the streams is affected by climatic conditions such as the El Niño-Southern Oscillation, typhoons and tropical storms.

The permitting requirements for pond construction can be long and cumbersome, especially if the property is a wetland. The effluent from the pond requires a permit, also.

The availability of cultural stock, reliability of the supplier and transportation connection from off-island suppliers impacts a farmer's decision of what to raise. However, what species is to be introduced on island is regulated and carefully inspected by the DAWR.

The availability of reliable electrical power can mean the difference between success and failure for the aquaculture farmer. Aeration of the ponds may be needed at night during periods of high algal productivity when the algae compete with the cultured species for the available dissolved oxygen in the water.

The danger of any cultured species escaping from the ponds and becoming established is very real. Non-indigenous species pose a very serious threat to plants and aquatic resources. We are aware of two species that have escaped from ponds and have become established on island; one is

a fish, commonly called snakehead; and, the other is a snail called apple snail. The snakehead is an aggressive fish and it may have an adverse impact on the aquatic fauna in the Ajayan River. The apple snail is a serious agricultural pest.

I have briefly reviewed the past and touched on some of the problems that aquaculture farmers will encounter or have to consider in their decision-making on whether to continue in or enter aquaculture farming. I will next touch briefly on this workshop's theme of "Aquaculture: Present and Future."

At present, there are only two or three aquaculture farmers on island. You heard a practitioner speak before me so that I will not dwell unnecessarily on the present.

That leaves the future of aquaculture to consider and the picture that I see is a dismal. The aquaculture industry has become a victim of our economic development and high standard of living. It will be very difficult for us on Guam to compete with our neighbors who can produce aquaculture products at a considerably lower production cost. Locally, the competition for land use with a higher economic return will discourage or deter anyone interested in aquaculture.

But, there are positives for aquaculture on Guam, too. Our climate should allow for more "crops" per year. Our proximity to Japan makes it a potential market, if we can ever overcome the barriers in their marketing system.

Let me conclude my presentation by citing another quotation. The worst thing about history is that every time it repeats itself the price goes up – Pillar.

Thank you. ❖

Agriculture and GovGuam

Sen. Jose T. San Agustin, chairman
Committee on Economic-Agricultural Development and Insurance

As far as I'm concerned, as long as there is someone willing to work the land, there will be agriculture on Guam. But perhaps I'm guilty of over simplifying. Perhaps the question should be, "Is there a future for agriculture on Guam if the Government of Guam stops paying for it?"

Perhaps I am guilty of being too direct.

I know farming is hard work. I know it requires more than just some dirt and a shovel and a prayer.

But, it is getting harder and harder to bite my tongue before I say, "ENOUGH IS ENOUGH"!

Are the people of Guam paying for a vital agricultural industry? Or are we paying for someone's hobby? There are moments when I have to wonder, and I know that I am not alone.

The biggest complaint I hear from the would-be buyers of locally grown goods is the farmers are not reliable. That's a very dangerous complaint. We all know about supply and demand. We also know that the more the demanders are disappointed by the suppliers, the harder it will become to find future demanders, especially demanders that have gone onto reliable suppliers. The buyers of produce cannot feed their customers promises.

The farmers have their complaints. They say the Government of Guam needs to give more.

More Land....

More Equipment....

More Money....

There are older farmers, here on Guam, that talk about how the government used to do so much for them. There were more low interests loans, more land was available for the asking ... why even crops were sprayed by the government!

Times have changed. The Government of Guam, the people of Guam, can no longer afford to operate farms.

What I propose is NOT radical. Farmers cannot be cut off and left to fend for themselves. But it can't be all give and no take.

I am not going to drone on with the shocking statistics about who is receiving what under the guise of being a farmer and how little, if anything, is produced. Those who have exhibited nothing more than a talent for getting something for nothing have hung their burdens around the necks of the hard working farmers. The productive farmer is being strangled by these burdens.

What I find very ironic is that farmers ask for help from the Government, then turn around and say, "Do not stick your nose into our farming business."

Talk about biting the hand....

Perhaps we in the government have not been diligent. Perhaps if we had made a few guidelines many years ago, and stuck to them, then we wouldn't have to worry about our agricultural industry now. Those guidelines would have weeded out – pardon the pun – the people just looking for land and saying anything to get it and the truly serious farmer. Guidelines that said, "We will give you this but in return, you will help us feed our people." And we should have stood firm in our belief that we could feed our people with a vital agricultural industry. And we should have said sooner, rather than later, "you are not helping us feed our people."

We are talking about simple thoughts plainly stated. What is a farmer? What can realistically be produced on a half acre, or a full acre. Grades and Standards for the goods produced.

We didn't do that. In some cases it may be too late. But it is not entirely too late.

We can still attempt to overhaul our agricultural industry. A new planting season, if you will. It will involve tough choices. Painful honesty. Immense follow-through.

Changes are not to be taken lightly. Wisdom and reason must prevail. But I know better than to tell the professional farmers here about the value of pruning.

We must make something very clear. If you are serious about being a farmer, we WILL help you. If you have an idea about products made with our crops, we WILL listen.

We have already proposed legislation for the benefit of our farmers and our fishermen.

Such as Bill 22 – the Farm Bill – which mandates that government agencies (the departments of Education, Corrections and Youth Affairs, and the Guam Memorial Hospital, to name a few) – must give preference to local farmers and fishermen before purchasing from off-island and other markets of fishing industries owned by foreign countries. Bill 22 even amends local procurement method laws that will cut down on some of the “red tape” that our farmers and fisherman have had to go through in the past.

This overhaul can lead us to a day when we are less dependent on imported produce. We are feeling this dependency now, in the form of the lettuce shortage because of flooding in California. We are paying higher prices. And there are the times when NO AMOUNT of money will bring us the FOOD we need. May I remind you of the days following the August 8, 1993, earthquake. Our commercial port was crippled for weeks. Produce disappeared from the shelves until the air freight brought very expensive goods to us. I challenge you: feed our people. Don't be shy about being the professionals that you are. Work with us.

And perhaps we will never again need to meet for another “Is there a future for Agriculture on Guam” workshop. Let our public market, our restaurants, and our dinner tables be the silent answer to that. ❖

Marketing Agriculture

Frank B. Aguon, Jr., director
Department of Commerce

I would like to initially take this opportunity to congratulate the numerous government of Guam agencies and private organizations for coordinating today's conference on agriculture. If you were to reflect on the focus of today's conference, "Is there a future for agriculture on Guam," I am sure that without hesitation most would respond in an affirmative manner. We are all here today to share our ideas and expertise on the future of agriculture on Guam and where we should go from here to insure its sustenance, growth and expansion.

The coordination of this conference is certainly a positive effort towards reemphasizing the importance of agriculture to our community and acknowledging the need to foster the growth and development of the industry.

Marketing, effective marketing, is an integral aspect of a successful agriculture industry on Guam. Successful marketing efforts and activities will certainly enhance the opportunities available to our island farmers, businesses, and the people of Guam.

There are two very important concepts of marketing agriculture that immediately come to mind. The first, is the marketing or promotion of agricultural products to established businesses and facilities in our local economy. The marketing sources exist for Guam's traditional industry to prosper and expand in the future. These include the hotels and restaurant facilities, the retail store outlets, the government agencies (both local and military facilities), in addition to other local target markets. The ongoing demand for agricultural products by these identified markets provides justification that extensive growth and expansion in the agriculture industry in the future is certainly possible.

A second approach to marketing agriculture, that I consider integral in the promotion, preservation and advancement of agricultural activities on Guam, is the marketing of agriculture directly to the island community, the people of Guam, specifically to our children, teenagers and young adults, through education and hands-on experience. Agriculture has long been a major contributing industry on our island, and our people have directly benefited from it for many years. Extensive efforts must be made on educating and training our children and future generations on the importance of agriculture to Guam's economic independence, so that they may appreciate the benefits and contribution that the agriculture industry makes to our people and our local economy. Such marketing efforts may be encouraged through island school, village, or island-wide projects.

In successfully marketing agricultural farm products, businesses or purchasing facilities consider two major factors, these are the quality of the products being marketed and the consistency of the supply. Our island farmers must always work towards insuring the quality of their goods, and must also be able to supply such goods as demanded by the market conditions. Ideally, if our local agriculture industry was to effectively provide produce and other farm items that can be produced or grown on Guam, this would minimize the need for imported farm products from other countries. With the continuous growth in population, both in Guam and in the surrounding region, the demand for agricultural products will continue to increase, thus creating greater opportunities and challenges for local farmers to meet this anticipated increase in demand. Furthermore, the growth of our island's number one industry, tourism will also increase the demand for locally grown produce and livestock.

A marketing concept that has been experimented with in the past and which has to some degree been a success is the establishment of a Guam Farmer's Cooperative, a non-profit organization specifically created with the mission to assist local farmers in every aspect of their farming activities. A farmer's coop to successfully operate must be managed like a private business with the ultimate goal to support the member farmers through providing the following, and possibly more:

- ✓ Purchase necessary farm supplies/seeds/equipment/animal feed in bulk and resell to member farmers at below market cost.
- ✓ Provide farmers with necessary training and education in farming activities and in new farming technologies and innovations.
- ✓ Serve as a marketing agent for the farmers by marketing, promoting, selling and distributing the produce or farm goods, thus enabling farmers to concentrate on their farming activities.

The idea of the Guam Farmers Coop is an idea that I feel should once again be aggressively explored and reestablished. If operated and managed effectively, the local farmers, businesses, and the island consumers would benefit from steady production and supply of quality local agricultural produce and livestock.

A major support component which will contribute to the enhancement, development and growth of the agriculture industry on Guam is the support by our local government. Although government agencies in the past have provided financial, technical, and service assistance to farmers, the renewed commitment by the government of Guam through the Gutierrez/Bordallo Administration, which has filtered to the directors and administrators of agencies that support and work closely with our local farmers, offers our agriculture industry a renewed assurance in fostering its growth, development and expansion. The Department of Commerce, for example, offers a venue to our local island farmers to sale their produce and ornamental plants at the Chamorro Village.

A particular agricultural business has recently expanded its market base to include the CNMI. This is in addition to providing quality, fresh products to the local market. The Chamorro Village will be constructing an additional structure that will accommodate the marketing and sale of aquacultural products.

As we review and discuss the very important aspect of marketing agriculture on Guam, we must be aware of these major concerns:

- ✓ The local business community and the people of Guam expect quality farm produce/livestock from our local farmers and consistency in the delivery of these items;
- ✓ Marketing must focus on the relationship between farmers and business establishments and, just as importantly, on our children and future generations, who will directly affect the continuation of the agriculture industry on Guam as our island's future farmers;
- ✓ Government and community support must be evident through community activities.

I believe that with the collective support from Gov. Carl Gutierrez and Lt. Gov. Madeleine Bordallo, the island farmers, and the community, the future of agriculture looks quite promising. As our island's traditional industry, agriculture will continue to contribute to our local economy. As concerned leaders and island citizens, we must work collectively on the promotion, growth, development and expansion of Guam's viable and established industry, thus insuring that there is a future for agriculture on Guam. ❖

Tourism and Agriculture

David B. Tydingco, president
Guam Hotel & Restaurant Association

Visitor Industry Background

Guam's tourism economy is on a rebound with more than a million visitors recorded in 1994 and, at the present rate, close to 1.2 million visitors expected in 1995.

With anticipated increase in visitor arrivals comes the increase demand for more produce for meals to be served at all hotels and restaurants on island.

Average stay of our visitor population is four nights, three days.

Expected meals to be served is 9 million meals for our visitors (1.2 million x 2.5 meals x 3 days), not including local consumption.

Is there a future for agriculture on Guam? I believe the obvious answer is yes, under certain conditions.

Hotel/Restaurant Consumption

Conservative estimates on consumption of sample produce:

- ✓ Eggs: four million eggs per year (80% of visitor population x 2 eggs x 3 meals-breakfast only).
- ✓ Cucumbers: 86,500 lbs per year (80% of visitor population x .02 lbs per visitor x 1.5 meals x 3 days).
- ✓ Tomatoes: 173,000 lbs per year (80% visitor population x .04 lbs per visitor x 1.5 meals x 3 days)
- ✓ Eggplants: 130,000 lbs per year (80% visitor population x .03 lbs per visitor x 1.5 meals x 3 days).

What do Restaurateurs Need to Support Operations?

Restaurateurs must provide a certain level of quality and consistency in the meals served. Therefore, availability of certain staples that can be grown and harvested year-round can provide a foundation for farmers. Quality of the product produced must meet certain standards so that consistency in the meal prepared is maintained.

Seasonal items as well can be rotated onto the menu as long as information is provided on when to expect produce and harvest period.

Suggestions

Educate hotels/restaurants on product availability. Forums such as these are an excellent beginning.

Cooperatively plan the growing season.

Employ distributor(s) to assure timely delivery of product.

Conduct meetings with hotels/restaurants to allow for constant feedback for the buyers/producers. ❖

Another Perspective: the Military Marketing

Richard Cook, commissary officer

In support of a Global Networking, the Defense Commissary Agency (DeCA) sources the majority of our produce through the Defense Personnel Support Center (DPSC) which is delivered weekly from California. A recently implemented Controlled Atmosphere Reliable Transportation System (CARTS) now provides the Guam Commissaries with approximately 95 percent or more marketable product. Previously, fresh produce was unable to survive the 11 days it took for conventional shipping methods to make the 6,000-mile ocean transit. Additionally, the controlled environment in which the produce is stored kills harmful insects. The CARTS system has also caused the discontinuation of harmful pesticides containing gases that help destroy earth's ozone layer.

Although the CARTS program has greatly increased survivability of produce, there are still items that require weekly air shipment due to their sensitive nature, i.e., bananas, mushrooms, herbs, green leaf, redleaf, romaine, parsley, bell peppers.

DPSC has initiated a global sourcing initiative. Through this program DPSC personnel "scout" potential worldwide markets to provide FF&V – specifically bananas, mangoes, papayas, pineapple and tomatoes – for Guam. The global sourcing initiative could be applied to Guam if adequate supplies, quality and competitive pricing could be provided. The new Orote Commissary will provide double the area that our current produce department provides and an area could be set aside for FF&V indigenous to Guam.

DeCA's criteria for purchasing produce are quality, price, and service. Our produce is inspected upon receipt by staff Army Medical Inspectors for saleability, i.e., quality, freshness, color and appearance. Price adjustments or credits are required for deteriorated or poor quality merchandise.

We are currently purchasing watermelon, Japanese cubes, bitter melons, eggplants, opo squash, cantaloupes in season, long beans, boonie peppers, papayas, mangoes and cherry tomatoes in limited quantities from Isla Growers, David Taitague Produce and Salas and Sons Produce. We would also be interested in sourcing lemons, limes, breadfruit, pineapple, cabbage, ginger, bell peppers, avocado, pomellos, coconuts and bananas from Guam suppliers.

Cost, quality, supply and guaranteed sale of product are the main determining factors for locally procured produce. Examples of weekly sales are as follows:

- ✓ Tomatoes - 1400 lbs
- ✓ Mangoes - 2500 lbs
- ✓ Papayas - 250 lbs
- ✓ Pineapple - 450
- ✓ Plantains - 250. ❖

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