V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Aquaculture

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
135	Aquatic and Terrestrial Wildlife	10%		5%	
136	Conservation of Biological Diversity	10%		10%	
301	Reproductive Performance of Animals	20%		20%	
302	Nutrient Utilization in Animals	10%		10%	
307	Animal Management Systems	20%		20%	
308	Improved Animal Products (Before Harvest)	10%		15%	
315	Animal Welfare/Well-Being and Protection	10%		10%	
511	New and Improved Non-Food Products and Processes	10%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

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

Year: 2009	Extension		Research	
	1862	1890	1862	1890
Plan	6.9	0.0	5.0	0.0
Actual	7.5	0.0	2.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
110473	0	127198	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	34000	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

PCC: About 15,000 fingerlings of grouper were produced and distributed to fish farmers for grow out in cages. Natural spawning was observed every month for another species of rabbit fish, Siganus lineatus. Eggs collected yielded about 450 fry after 45 days. Another run showed improved survival rate to 5,200 pieces of fry. About 4,000 pieces of fry were stocked in private fish cages for nursery and grow-out trials. Rabbit fish fed with high protein commercial prawn feeds had fastest growth rate both in the nursery and grow-out stages compared to other feed sources. A series of larval rearing for mangrove crabs were conducted, however the crab larvae survived only up to 5 days after hatching. Efforts to improve the survival rate are undertaken. Wild milkfish fry caught have already grown into broodstock size. The body weights now ranged from 1,500 to 1,850 grams.

Program staffs have been assisting a government - owned hatchery in the larval rearing of groupers and maintenance and production of natural food organisms. Technical assistance to solve problems such as fish diseases and mortalities were provided.

CMI: A new aquaculture hatchery was dedicated and ready for operation. A visiting professor from Delaware State University spent three months conducting hatchery research investigating growth differences among the pearl oysters (P. margaritifera) stocked at three different densities. Another study was on oyster immunological and pearl oyster seeding trial. The aquaculture staffs, who were assisted by the professor, monitored the oysters in the farm and hatchery. Both elementary and high school students visited and toured the aquaculture facility.

COM-FSM: In one county, a WSARE proposal was approved for a trial/demonstration to improve chicken egg production using a feed from a mixture of the invasive tilapia fish species with other local ingredients. In another, black pearl extension work continued on a commercialization for training of local farmhands to maintain the farms and the pearl hatchery program continued its activity to simulate mass juvenile production for implementing commercial farming at three outer islands. Pearl research continued with the grant from the Center for Tropical and Subtropical Aquaculture (CTSA) to improve pearl quality by grafting and husbandry methods. The sea cucumber project continued on the hatchery technology transfer and resource enhancement in Pohnpei. The wild stock surveys were conducted on a high-value commercial species, the sandfish (Holothuria scabra), which indicated high resources in Pohnpei lagoon. Several thousand juveniles were produced successfully of which grow-out work was implemented by a land-based method.

2. Brief description of the target audience

Community fish farmers, government officials, elementary, high school and college students, researchers and extension agents, international and regional organizations, commercial businesses, foreign investors, NGOs and local residents.

V(E). Planned Program (Outputs)

1. Standard output measures

2009	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	450	2000	300	2000
Actual	468	1500	950	1336

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

Year: 2009
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2009	Extension	Research	Total
Plan	0	0	
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of demonstration farms established.

Year	Target	Actual
2009	6	8

Output #2

Output Measure

- Number of publications for lay use.

Year	Target	Actual
2009	4	4

Output #3

Output Measure

- Number of conference paper and publication/presentation.

Year	Target	Actual
2009	5	2

Output #4

Output Measure

- Expected Professional Journal publications.

Year	Target	Actual
2009	6	1

Output #5

Output Measure

- Expected Gray Literatures.

Year	Target	Actual
2009	6	3

Output #6

Output Measure

- Expected publications for lay use.

Year	Target	Actual
2009	5	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increase awareness in the communities and prospective and existing industry about sustainable, site-specific, and low energy aquaculture technologies.
2	Adoption of sustainable aquaculture technologies by commercial and community groups.
3	Number of established aquaculture operations.

Outcome #1

1. Outcome Measures

Increase awareness in the communities and prospective and existing industry about sustainable, site-specific, and low energy aquaculture technologies.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	80	1295

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Fish farmers and entrepreneurs have limited knowledge on current aquaculture technologies and selection of appropriate sites for farming. People have realized that aquaculture farming will provide for food security and enabled income generation. Pearl culture, sea cucumber, and other marine species can be raised successfully with appropriate infrastructure and resources.

What has been done
Posters of hatchery-produced rabbit fish and grouper fingerlings were displayed at national events and lectures on aquaculture were conducted in different communities and schools. Hands-on training in hatchery and farming were provided and staff participated in aquaculture workshops and conferences. On-site visits were facilitated to students and others at hatchery facilities and aquaculture information were aired via local radio stations.

Results
PCC: People have realized the importance of aquaculture for food security and economic development. They were able to understand the life history of rabbit fish, groupers and mangrove crabs. Students learned the basic concepts in aquaculture and have shown interest by participating in discussions and lectures. Aquaculture personnel, both in the private and government institutions, learned latest technologies that can be adopted and learned basic things to consider when selecting aquaculture farming sites.

CMI: Government officials seek advises from aquaculture staff. Also, assistance from staff to help develop proposals still continues.

COM-FSM: The pearl project received immediate attentions from domestic and overseas stakeholders and international journals on high quality products of the round and half-pearls. The sea cucumber project developed its own grow-out technique by a land-based method, which caught international attentions in the sea cucumber aquaculture research.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals

307	Animal Management Systems
308	Improved Animal Products (Before Harvest)
315	Animal Welfare/Well-Being and Protection
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

Adoption of sustainable aquaculture technologies by commercial and community groups.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	20	43

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Local communities are realizing the importance of aquaculture farming as a means for food security and improving quality of life. Disease and parasitic organisms are affecting fish stock. Fish farmers have limited knowledge of proper feeding management of cultured fish and appropriate sites to set up farms.

What has been done
Aquaculture staffs continued farm work and monitoring existing pearl oyster and sea cucumber farms. Grouper stock was examined for presence of bacterial and parasite infections using formalin bath, with frequent changing of nets and food. Correct feeding management and use of commercially available pelletized fish feeds were evaluated. Another species of rabbit fish, Siganus lineatus, was introduced for grow-out in ponds and cages and staffs provided assistance in assessing suitable sites for fish cage farming.

Results
PCC: Clients learned to solve disease problems and other issues affecting grouper and rabbit fish aquaculture farming. Giving the right amount of feed and regular sampling enables farmers to monitor the growth performance of rabbit fish in ponds and cages. Fish farmers were able to identify appropriate sites for aquaculture farming.

CMI: One of the farms shut down after the sudden death of its manager. The other five are still in operation.

COM-FSM: Pearl project staff began farm design, set up and maintenance, as well as hatchery juvenile production. This reflected local awareness in immediate pearl farming business investment and conservation activities like in Pakin Atoll in Pohnpei. Wild stock survey in Pohnpei lagoon revealed a higher-resource of the high-value sandfish (H. scabra) than those estimated earlier, which is encouraging for re-stocking purpose.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)
315	Animal Welfare/Well-Being and Protection
511	New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

Number of established aquaculture operations.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2009	5	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
PCC: Hatchery -bred fingerlings of rabbit fish and grouper can be successfully grown to marketable size in fish ponds and cages using appropriate feeding management and disease prevention technologies. Appropriate technologies on feeding management and disease prevention and cure should be available to aquaculture farmers.

CMI: The community is beginning to realize the importance of aquaculture farming as a means for food security and income generating.

COM-FSM: Communities in Pohnpei still lack a fisheries management plan and capacity building for residents must be strengthen.

What has been done
PCC: Hatchery - bred rabbit fish fingerlings were delivered to a farm and grouper fingerlings were released to cages. Proper feeding management, stock manipulation and monitoring of stock were taught. Staffs conducted on-site assessments and recommended disease treatment to solve parasite and bacterial infections of grouper and milkfish stock.

CMI: Aquaculture staff continued working and monitoring of existing oyster farms in the outer islands.

COM-FSM: Pearl farm training was offered to youths in three communities in preparation for upcoming commercial activities. The sea cucumber hatchery produced thousands of juveniles for restocking purposes.

Results
PCC: The fish farm growing rabbit fish in cages was able to harvest marketable size rabbit fish after 6 to 8 months of culture. Grouper farmers were able to harvest marketable size groupers in cages although problems of parasite infection were encountered. They learned practical methods to control parasites and bacteria that adversely affect their stock.

CMI: One of the farms shut down after the sudden death of its manager. The other five are still operational.

COM-FSM: Pakin atoll community commenced its own farm maintenance work with 10,000 2-year-old pearl oysters which were donated by the COM pearl project. Other two outer island communities deployed line culture systems for commercial operations. The sea cucumber project repeated hatchery spawning-runs which produced several thousands juveniles. Wild stock surveys also involved local people to locate commercially high-value sandfish specie (H. scabra).

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
301	Reproductive Performance of Animals
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V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Government Regulations
- Competing Public priorities

Brief Explanation

PCC: Poor survival of mangrove crab larvae was influenced by limitations such as power interruptions, poor water quality, and fluctuation of water temperature due to poor hatchery ventilation. Seed production of mangrove crab will be improved once the larval rearing activities are conducted in the new PCC Multi-Species Hatchery."

CMI: The death of one of the farm managers caused for his farm to shut down operations. The mechanical problem that the domestic aircraft experienced caused a delay in the monitoring of farms.

COM-FSM: As has been exhibited by one of the outer islands in Pohnpei i.e. Nukuoro Atoll, who used to have pearl farm business based on collecting wild pearl oysters in its lagoon, over-expectations about pearls at retail outlet overseas lured a community-owned Nukuoro pearl management without going through strict product quality control by pearl grading and pricing, appropriate farm skill training, business planning and marketing/sale development. Pearls and pearl-related products are regarded as export commodity and therefore national, states and local governments needed to develop coordinated efforts on international marketing strategy and financial and vocational planning in a sustainable economic development. COM pearl project involved a qualified pearl grader (US Gemological Institute of America) as well as a master technician of pearl nucleus implantation to support quality control during the pearl quality improvement research and sales and branding promotion. One of the weakest points of the remote islands in developing internationally competitive export business is disunity or disorganized activities. Each atoll pearl farmers need to be supported to develop a state-wide pearl farmer's association or cooperatives, which could be provided technical advices by the US Rural Development through COM Land Grant Program research and extension services. Regarding the sea cucumber resource enhancement project, the Pohnpei State Government Division of Fisheries and Aquaculture should take more active roles in fisheries management policy review processes and strategic planning. Current sea cucumber fishing total ban on all species should be reviewed based on a

comprehensive wild stock assessment work and by introducing species-specific restriction, size (wet weight) limit and/or fishing ground protection. This is because that a monitoring program has not been seen and that illegal fishing for export of small quantity of H. scabra has been carried out for more than a decade even though the State Government has imposed ban and some areas of H. scabra habitat indicated higher resource than it was expected as near-extinct status.

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

1. Evaluation Studies Planned

- After Only (post program)
- Before-After (before and after program)
- During (during program)
- Time series (multiple points before and after program)
- Comparisons between program participants (individuals, group, organizations) and non-participants
- Comparisons between different groups of individuals or program participants experiencing different levels of program intensity.
- Comparison between locales where the program operates and sites without program intervention

Evaluation Results

PCC: In previous years, people in Palau were dependent on the fish caught from the wild. With the success in producing fingerlings of rabbit fish and grouper in the hatchery, the public are now aware of the potentials in growing these important fish species in ponds and cages. More and more people are interested in growing fish for commercial purpose. Fish farmers encountering problems of mortalities in their ponds and cages now know how to identify the cause of mortalities and treat the fish. More students are now eager to learn more about the biology and culture of fish since they participate more actively in discussions during lectures and study tours. There is an increase in number of ponds and cages for grow-out of milkfish, rabbit fish, grouper and mangrove crabs in Palau .

CMI: Two farms have already had their oysters seeded. They both have already informed the other three farm owners that they are ready to buy to their oysters if they are not planning to have them seeded. An off island Seeder was contracted to seed the oysters at a rate of $1 per oyster. A local person needs to be trained in this skill of seeding oysters.

COM-FSM: The communities have been positive in taking actions by establishing community-owned pearl farms. Following several years of skill training and demonstrations by the COM pearl project, Pakin Community Association was organized. Leading youths were nominated to continue skill training for their own people and a number of participants increased. The sea cucumber hatchery technology was transferred successfully for the high valued species (H. scabra), a commodity of high potential to contribute to additional source of income. The project's hatchery-based aquaculture work enabled the Pohnpei State Government to collaborate closer to review and improve management planning.

Key Items of Evaluation

PCC: A practical method in larval rearing of two rabbit fish species has been documented with the success in natural spawning of the captive breeders. A nursery and grow-out of rabbit fish in cages has been verified and better feeding protocol was developed. PCC-CRE has succeeded in producing high - valued aquaculture species such as grouper which gave an opportunity to fish farmers experience growing the locally hatchery - bred grouper in their facility. Staffs continuously demonstrated to their clients basic developments and the potentials of aquaculture in Palau. A technique for seed production of mangrove crabs in Palau is being developed. Basic considerations and requirements in selecting appropriate sites for fish ponds and cages has been recommended to interested individuals and government agencies.

CMI: Need to conduct training on seeding oysters for local citizens. Marketing and Pearl grading skills are important and therefore need to organize future trainings for current farmers and interested citizens.

COM-FSM: Pearls and pearl-related value-added products (e.g. half-pearls) are getting more attentions among local and international stakeholders such as in Japan and USA. Some sample products have been sold overseas for developing marketing and branding strategies i.e. the Micronesian Pearls. Unique and valuable colorations of pearls from the project's cross-breeding programs has created positive responses and enquiries have already been received from overseas for investment opportunities in establishing joint venture pearl farms and joint sales promotions. In the case of the sea cucumber (H. scabra), the project's wild stock survey revealed higher abundances in the Pohnpei lagoon, twice as many sandfish found at night (4.3 sandfish/staff-hr.) compared to the daytime survey (2.2) by the CPUE (Catch Per Unit Effort) method. For estimating the resource per hectare (10,000 square meter), LT (Line Transact) method showed 122.2 sandfish at daytime and 88.9 at night. Both results by CPUE and LT methods gave surprisingly higher figures compared to those reported in the past stock studies in Pohnpei during 1996 &ndash 1998 by the Japanese OFCF (Overseas Fishery Cooperation Foundation and Pohnpei State Marine Development) and in 2004 by the College of Micronesia - FSM, who concluded that the sandfish had been depleted to near extinct or nil in Pohnpei lagoon. This suggested a need to revise survey methodologies of the past published by others in FSM as well as overseas, who only conducted daytime surveys. The sea cucumber aquaculture project has a potential to re-vitalize local economy in Pohnpei.