V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Aquaculture

☑ Reporting on this Program

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%		10%	
136	Conservation of Biological Diversity	10%		10%	
301	Reproductive Performance of Animals	10%		10%	
302	Nutrient Utilization in Animals	15%		15%	
307	Animal Management Systems	15%		15%	
308	Improved Animal Products (Before Harvest)	10%		10%	
315	Animal Welfare/Well-Being and Protection	10%		10%	
511	New and Improved Non-Food Products and Processes	10%		10%	
608	Community Resource Planning and Development	10%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	4.0	0.0	3.0	0.0
Actual Paid Professional	5.2	0.0	2.5	0.0
Actual Volunteer	0.0	0.0	0.0	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**
139663	0	122128	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
11857	0	0	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: Hatchery produced crablets with total carapace length was about 2 inches were given to two local crab farmers for grow-out trial in pens inside the mangroves. A floating fish cage was completed and was stocked with rabbitfish and milkfish broodstock. Walk-in visitors, school children and people in the government visited the hatchery and fish cages to observe the on-going aquaculture activities.

CMI: Three spawning runs for the production of pearl oyster spats were conducted and some spats were brought to a pearl farm. The remaining spats were kept at the college's farm waiting for shipment to other farms. New batches of rabbit fish brood stock were collected and spontaneous natural spawning was recorded. Viability of spawned eggs and hatching rate were close to 100% and preliminary larval rearing trial was conducted. Five on the job local trainees were hired learned the basics of pearl farming and one of them was able to establish his own farm. Three atolls were visited and lectures and site assessment were conducted in line with aquaculture development. Local farmers growing rabbit fish in cages were visited and technical assistance was provided.

COM-FSM: Total of eight spawning-runs was conducted over one year period to settled approximately 100,000 early stage juveniles of sandfish sea cucumber. Tagging trials were also conducted for the wild-caught and hatchery-produced sandfish in Pohnpei. Pohnpei's pearl project conducted a half-pearl or hemispherical pearl production, of which activity focused on skill training of the half-pearl nuclei implantation, harvesting and processing techniques for the extension staff and for the local youths. The cultivation period of half-pearls was 7-10 months from nucleus implantation to the harvest, which was greatly shorter than those round-pearl farming. Four local communities of Nett, Pweniau Island, Pakin Atoll and Pingelap Atoll joined skill training on the half-pearl seeding and pearl accessory making, which involved 13 trainees for the seeding skills using 4,000 pearl oysters and approximately 150 people from four communities for the accessory making, respectively. 3,000 oysters were harvested and produced over 10,000 half-pearls. The training programs also involved three interns from COM-FSM Marine Science. For local sales and marketing promotion of the pearls from the project, display-charity sale was conducted in Pohnpei, which sold $15,000 of the round-pearls and $500 of half-pearl accessories in one day session. Both In Pohnpei and Yap, sea cucumber aquaculture workshops were conducted with the onsite demonstrations of hatchery operations and tagging practices. In Yap, approximately 1,000 tilapia were successfully removed from mangrove ecosystem in one of the two communities involved, of which

captured animals were used as the feed for chicken farming.

2. Brief description of the target audience

PCC: Existing fish and crab farmers, students, government officials, traditional leaders, tourists and the general public are the target audience of aquaculture activities in Palau.

CMI: Community leaders, tourists, diplomats, local governments, and students were the major target audience.

COM-FSM: Communities and families who participated in pilot farming programs, state and municipal governments personnel who collaborated on aquaculture activities, overseas governments and international agencies who showed their interests in economic development supports in this region and local and overseas business owners who expressed interests in investment to aquaculture business were the target audience. Furthermore, secondary and tertiary students, members of youth activities and women's group were also important target as the majority of them were under-privileged but becoming potentially vehicles of aquaculture industry once it is developed. Scientists and professionals overseas were also target audience through international conferences and internet presentations such as using You-tube for disseminating unique tropical aquaculture research and extension work undertaken in this country

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	377	2100	265	1055

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

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	1	1	2

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of demonstration farms established.

Year	Actual
2012	6

Output #2

Output Measure

- Number of publications for lay use.

Year	Actual
2012	3

Output #3

Output Measure

- Number of conference paper and publication/presentation.

Year	Actual
2012	3

Output #4

Output Measure

- Expected Professional Journal publications.

Year	Actual
2012	1

Output #5

Output Measure

- Expected Gray Literatures.

Year	Actual
2012	5

Output #6

Output Measure

- Expected publications for lay use.

Year	Actual
2012	2

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	Actual
2012	475

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
PCC: People have limited knowledge on how to grow mangrove crabs. Existing farms have small or undersized wild-caught crabs. Rabbit fish were grown mainly in pen-enclosures which are difficult to manage.

CMI: Fishes are getting scarce and people are unfamiliar with fish farming. Sea cucumber resources decreased from over-harvesting.

COM-FSM: Marine resources are abundant, but low-tech and high skill aquaculture methods were of little practice for sustainable income generation.

What has been done
PCC: Seed production project on mangrove crabs was initiated. A floating fish cage was demonstrated.

CMI: Pearl oyster spats were delivered to farmers. Assessment and interviews on sea cucumber fishing were conducted. Rabbit fish brood stock were collected and interested individuals were identified.

COM-FSM: Half-pearls seeding and accessory making trainings were conducted and the land-based long-term culture system was developed by simulating natural habitats for the hatchery-based sea cucumber farming.

Results

PCC: Number of individuals increased who wanted to establish their own mangrove crab farms. Some fish farmers were interested in the floating cage design for grow-out.

CMI: Pearl farmers expanded their farms. Some individuals started collecting wild rabbit fish fingerlings and grow them in small fish cages. Number of individuals increased including students who were interested in rabbit fish farming.

COM-FSM: High skill was acquired by Micronesian technicians and trainees who produced high quality half-pearls and accessories as value-added pearl shell products, which gained attentions from domestic and international jewelry industry. Trainees from three outer islands acquired pearl farming skills except for their financial management issues.The habitat simulator system for the sea cucumbers, or the land-based long-term, low-cost and low-tech culture system, enabled training programs to repeat 8 spawning and larval rearing followed by juvenile grow-out work.

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
608	Community Resource Planning and Development

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	Actual

2012 213

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
PCC: People have limited knowledge on how to grow mangrove crabs. There are existing crab farms but stocks are sourced from undersized wild caught crabs. Most of the cages used in growing rabbitfish were fixed type using pen enclosure which is difficult to manage.

CMI: People are not familiar with raising or growing fish. The sea cucumber resources are decreasing due to over harvesting.

COM-FSM: Locals are unfamiliar to jewelry or seafood production. Quality control of is key to export half-pearl jewelry. Hatchery method is a key as export ban exists for wild sea cucumbers.

What has been done
PCC: Seed production projects on mangrove crabs were initiated. A floating fish cage was demonstrated.

CMI: Seed production of pearl oyster continued and spats were delivered to farmers. Resource assessment and interviews on sea cucumber harvesting were conducted. New brood stock for rabbit fish was collected and interested individuals in farming rabbitfish were identified.

COM-FSM: Half-pearl seeding, accessory making and grading trainings were given to the outer islands. Sea cucumber hatchery trainings were conducted for Micronesian technicians.

Results
PCC: There was an increase in number of individuals who wanted to establish their own mangrove crab farm. Some fish farmers are interested to follow the floating cage design for growing fish.

CMI: Pearl farmers continued to expand their farms. Some individuals started collecting wild rabbitfish fingerlings and grow them in small fish cages. There are an increasing number of individuals, including students interested in rabbitfish farming.

COM-FSM: 13 trainees from three outer islands learned half-pearl seeding skills and 60 individuals from four communities joined half-pearl accessory making sessions. Project?s seven technicians were taught pearl grading by an expert. Sea cucumber, sandfish, hatchery skills were acquired by seven extension staff who managed to produce several ten thousand juveniles for grow-out work. Technology transfer was conducted from Pohnpei to Yap for the sandfish by demonstrating broodstock holding and spawning induction methods.

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
608	Community Resource Planning and Development

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	Actual
2012	25

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
PCC: Some crab farmers have experienced being fined by the fish and wildlife agency for catching and keeping undersized wild caught mangrove crabs in their farm. Those who are interested to grow rabbitfish loose interest because of so many problems encountered in managing a fixed pen enclosure.

CMI: People are not interested in growing fish.

COM-FSM: A family of Pweniau Island in Pohnpei joined pearl farming. Project?s pilot farms were transferred to each community. Sea cucumber hatchery project began in Yap.

What has been done
PCC: Crab and fish farmers were reached. Technical discussion was initiated and farmers were invited to visited PCC aquaculture facilities. Hatchery produced mangrove crabs and rabbitfish were introduced to existing farms for grow-out trial.

CMI: We continued seed production of pearl oysters, engaged 5 people for on the job training and local farmers were visited. Spawning of rabbit-fish was monitored and preliminary larval rearing trial was conducted. Resource and site assessment and aquaculture presentations were conducted in three atolls.

COM-FSM: Half-pearl seeding skill and accessory making trainings were offered to Pweniau family and 3 other communities. Hatchery setup and spawning techniques were demonstrated in Yap.

Results

PCC: Fish and wild life agency become aware about PCC?s effort to develop a sustainable crab aquaculture in the country. Crab farmers were able to stock hatchery produced crablets in their farms and on toward incidents for fines was no longer recorded. More individuals are interested to put up their own crab farm. PCC was encouraged to continue the seed production activities for both crabs and rabbitfish.

CMI: More people are interested in pearl oyster farming and another new farm has been established. CMI is now maintaining brood-stock for rabbit-fish and first spawning has been recorded. A number of individuals are now growing rabbit-fish in small cages and Rongelap government has started activities in growing fish in collaboration with CMI. People in atolls realized the impact of overharvesting sea cucumbers and started to create management plan to revive the depleted stock.

COM-FSM: Skill trainings of half-pearl seeding and accessory making created local technicians. 4 communities in Pohnpei produced more than 3,000 half-pearls each, which resulted in high quality products. COM collaborated with the government in Yap, in which sandfish hatchery workshop and onsite demonstrations were conducted by Pohnpei staff.

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)
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V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

PCC: The absence of an aquaculture researcher slowed down the efforts to provide more developments. On-going research project on mangrove crab was put on hold and discontinued.

CMI: Accessibility is one of the main constraints in delivering services to outer atolls. A reliable boat with good engine is needed to reach islands and atolls. Staff should be re-certified for scuba diving so that farms will be assisted properly. Taiwan fish hatchery that was turned over to us needs further renovation to be more functional. Current design and condition of tanks are not suitable for fish larval rearing.

COM-FSM: As usual in this country, geographical vastness of the ocean and distance between the main land and the outer islands is a major bottleneck for any aquaculture industry to be developed. The college programs and the participating outer islands always faced financial shortfalls from high fuel cost for transportation and maintaining electrical equipment.

In general, creating highly skilled technician who is supposed to be a vehicle of future industry is not a public sector's playground but is played by a private sector itself. Half-pearl project was formed to supplement the round-pearl farming development. However, island people became focusing on the half-pearl production as a sole commodity and they expect a public sector's urgent sales development activity. Without the government's rigorous support and activity into island business development, this project would end as just a college training materials. So far, no tangible support has been provided by national and state governments. The sea cucumber businesses are still based on greed or boom-and-bust activities by fake aquaculture operators of which hatchery or grow-out facilities cover-up illegal stock piling of the wild-caught animals for processing and exporting overseas. Lack of knowledge about the sea cucumber business is a problem of the extension staff and educating such staff is first step to disseminating latest information to the outer island people.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

PCC: Existing fish and crab farmers were able to benefit from the crablets and

rabbitfish juveniles that were produced. The existence of hatchery and floating fish cage demonstration facilities provided a good example to interested farmers.

CMI: Existing pearl farms have benefitted from the oyster spats that were produced in the hatchery. More individuals are now interested in pearl farming and culture of finfish. People in atolls are now aware about the importance of aquaculture and were able to identify local species that have potential for aquaculture. Students and people in the community are aware about the impact of over harvesting marine resources and that a good management plan is necessary to revive the depleted stock.

COM-FSM: Half-pearl seeding technology transfer among the Micronesians was successful in producing high quality pearls produced by those trainees. Daughters of the families from Pakin Atoll and Pweniau Island seeded 1000 oysters each and harvested more than 3000 half-pearls each. Series of accessory making sessions attracted more than 60 trainees from four communities and those produced half-pearls became materials for unique Micronesian half-pearl pendants and earrings, which fetched average $20 per piece at charity sale in Pohnpei and samples sold at overseas jewelry outlet priced from $75 to $150 per piece. Half-pearls with unique bluish color and with significantly shorter cultivation period between 7 to 10 months than those of the round-pearls received more interests among the businesses both domestic and overseas markets. All the oysters were originated from the COM's hatchery project. Tropical sea cucumbers were listed by Food and Agriculture Organization of the United Nations as a primary aquaculture commodity in Asia and the Pacific region. Because the wild stocks of commercially high-valued species such as the sandfish were almost depleted in many islands, the governments imposed total export ban or restricted resource management plans which only allow aquacultured animals to be exported. Unfortunately, hatchery technologies of the tropical sea cucumbers such as the sandfish were not established widely in this region. The sea cucumber project of COM-FSM was a challenge to develop its own methods for broodstock holding, spawning induction, larval rearing and juvenile grow-out. During this reporting period, a long-term and low-cost semi-recirculating seawater system proved to be effective for continuous use for both research, training and demonstration purposes. Spawning induction technique was also standardized in this climate. COM's extension staff became core technicians to continue training of other Micronesians. Workshops conducted in Pohnpei and Yap provided local and overseas participants a wide range of knowledge of sea cucumbers including biology, wild stock abundance and distribution, behavior, history of sea cucumber fishing, processing, commercial values and hatchery demonstrations. All the activities aimed to inspire local communities and individuals to develop small-scale sea cucumber farming.

Key Items of Evaluation

PCC: Despite of the absence of the researcher, aquaculture staffs were able to maintain the fish stock and the facilities as well. The reinstatement of an aquaculture researcher is very crucial in order to continue the development of aquaculture in Palau.

CMI: Pearl farmers have been experiencing difficulties in sustaining their operation due to scarcity of spats collected from the wild and CMI played important role in reviving the industry by supplying them with spats produced from the hatchery. Conducting field visits and aquaculture presentations to people in different atolls are important to make people aware about the importance of aquaculture and the conservation of marine resources. Rabbitfish is a potential species for aquaculture development in RMI and a number of individuals are interested to start commercial farming of this species.

COM-FSM: Because of distant and difficulty to transport and communicate to the outer islands, the project staff often postponed or cancelled onsite work of demonstration and training. Also, electricity supply was always done by a generator and bringing and maintaining electrical machines and tools into the outer islands were not as easy as in the main island of Pohnpei. These affected by slowing down progress of practicing accessory making on the outer islands. Therefore, the project main work of pendant making demonstration were often conducted in Pohnpei, in which only limited number of trainees were called to Pohnpei from the outer islands without involving entire family members. Sometimes those who invited joined but not continuously for longer months as they were unable to support themselves in Pohnpei. For marketing development, unless selling majority of the products domestically, regional promotion may be needed such as Guam as a jumping board for selling half-pearl products. In Yap, a small hatchery tank system which had been developed in Pohnpei as a habitat simulator was constructed for holding the sandfish at the Yap State Marine Resource Management and Development (MRMD). This was because of a series of meetings with the stakeholders during the first quarter of this reporting period, who expressed their interests, concerns and supports to the sea cucumber aquaculture as an important export business opportunity if it is implemented. However, MRMD was unable to secure to purchase necessary equipment and materials for a proposed hatchery construction. Therefore, maintenance and monitoring of the holding tank and animals were done by a COM-Yap aquaculture extension staff with minimum equipment. At this reporting date, a proposed hatchery site at MRMD has remained the same without a facility construction by the government for their hatchery-based sandfish project. In spite of these difficulties, spawning demonstration and workshop were conducted by during the third quarter. In Yap, approximately1000 tilapia was successfully removed from mangrove tidal flat area at one of the two communities, which were used as feed for chicken farming. This could show a way to eradicate invasive fish effectively by utilizing its fishmeal for local poultry business.