

ORIGINAL

# Present and Future of Aquaculture Research and Development in the Pacific Island Countries

Proceedings of the International Workshop  
held from 20th November - 24th November 1995  
at Ministry of Fisheries, Tonga

DEPARTMENT OF MARINE &  
WILDLIFE RESOURCES  
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## Country Statement : Western Samoa

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## 1. Land Facilities (hatcheries, nurseries, ponds, tanks, laboratories, etc).

Location	Category	Size	No.	Remarks
Fisheries Headquarters (Government)	Wet laboratory	5.35 x 7.73 m	1	- used to house freshwater prawn larval rearing tanks. Fresh-water, air and salt-water piping systems intact but only fresh-water system operational
	Spawning tanks (rectangular FRP)	95 cm x 233 cm x 69 cm high	2	- giant clams spawning induction operations
	Larval rearing tanks (conical bottom fiberglass)	2,000 liters	2	- for fresh-water prawns/giant clams larval rearing
	Concrete ponds	2 m x 10 m x 1.16 m	4	- for tilapia breeding / giant clams settling/nursery
	Concrete ponds	2 m x 10 m x 0.64 m	1	- for tilapia breeding/giant clams settling/juvenile land-based nursery
Solaua, Upolu (Private)	Earthen ponds	2,900 m <sup>2</sup>	3	- grow-out for freshwater prawns/freshwater crayfish - one was stocked with tilapia, <i>O. niloticus</i> but had problems with molly population and leaking, eventual complete loss
	Earthen ponds	1,740 m <sup>2</sup>	1	- grow-out ponds for freshwater prawns/freshwater crayfish - stocked with <i>O. niloticus</i> in October 1995
Salani, Upolu (Private)	Earthen ponds	5 x 10 m	3	- tilapia nursery ponds
	Earthen ponds	20 x 25 m	2	- tilapia grow-out ponds
Saluafata, Upolu (Private)	Cage	1.6 m x 1.6 m x 0.6 m	1	- tilapia cage culture
		8.3 m x 8.3 m x 0.6 m	1	- tilapia cage culture

## 2. Ocean Facilities.

Location	Category	Size	No.	Remarks
Vaisala, Savai'i (private/government)	Plastic trays in giant clam nursery	45 x 42 cm	40	- lagoon bottom culture of giant clams
Si'ufanga, Savai'i (private/government)	Plastic trays in giant clam nursery	45 x 42 cm	28	- lagoon bottom culture of giant clams (trays placed in protective cages)

## 3. Aquaculture production (latest figure).

Species	Location	Production (kg) and Value (\$)	Remarks
Tilapia, <i>O. niloticus</i>	Salani	25.5 kg from 1 pond	- high survival but very slow growth
Tilapia, <i>O. niloticus</i>	Salani	16.6 kg from 1 pond	- as above

#### 4. Brief History of Aquaculture Development in Western Samoa.

Aquaculture was not a tradition in Samoa. However, a traditional form of giant clam ranching was practiced on village reefs or lagoons where a community placed giant clams in a fenced off area for special occasions or reserves for seafood supply in bad weather. Details of aquaculture activities, including introductions, projects and results in Western Samoa are reported in Bell and Ropeti (1995).

##### 1). Aquaculture Study visits

The idea to initiate true aquaculture in Western Samoa came as early as 1954 when Mr. H. van Pel (Fisheries Officer, SPC) was sent "to investigate the possibilities of establishing fish ponds near Apia, on the Island of Upolu" (van Pel, 1954). van Pel recommended tilapia, *Oreochromis mossambicus*, as the most suitable fish for stocking ponds and suggested ordering fry from Fiji.

In 1971, FAO assigned an aquaculture consultant to investigate the possibility of aquaculture in the South Pacific and to study the soil and water conditions and design pilot scale experiments at suitable sites for determining the technical and economic possibilities of culture under local conditions (Villaluz, 1972). For Western Samoa, the consultant made the following recommendations concerning aquaculture development :

1. A thorough study of the fresh-water prawn population in the different river systems and fresh-water units be undertaken;
2. A hatchery laboratory near the mouth of the Falefa river be established with the endemic species of *Macrobrachium* as the object of the study;
3. River systems and other fresh-water units be used as the principal sites in the development of a *Macrobrachium* industry in the absence of fresh-water swamps suitable for conversion into fish ponds.

In response to a Western Samoa Government request, two consultants from AQUACOP conducted a study on the potential sites in Western Samoa for aquaculture in 1978. The consultants identified the Solaua area as a potential site for *Macrobrachium* culture and Safata Bay for mussel culture.

##### 2). Tilapia

The tilapia, *O. mossambicus*, was introduced from Fiji in 1955 for small-scale culture (van Pel, 1961, cited in Eldredge, 1994). By 1960, 46 natural and artificial fish ponds were already stocked in addition to a single breeding pond providing fingerlings for distribution (Anon, 1961). Some rivers were also reported to have been stocked with tilapia during these initial exercises. However, flooding was a problem in keeping stocks.

In June, 1991, the Fisheries Division imported 300 Israel tilapia, *O. niloticus*, from Fiji to serve as future stocks. Under South Pacific Aquaculture Development Project (SPADP) funding, a demonstration tilapia farm was initiated at Salani in 1992, and is operational. In 1994, 1,800 *O. niloticus* fry were imported from Fiji. These were stocked into the Salani ponds with some kept at the Fisheries hatchery to serve as broodstock. The hatchery is proving to be successful. Harvest results from the Salani grow-out ponds in 1995 were disappointing in that even though survival was high, growth was very poor. This has been attributed to poor pond construction and pond management. Tilapia cage culture within a natural lake was initiated at Saluafata in 1995. Additionally, one of the earthen ponds at the fresh-water crayfish farm at Solaua was stocked with *O. niloticus* supplied from the Fisheries hatchery in early 1995. However, the pond was infested with mollies and was leaking through the sluice gate. The pond eventually drained out completely resulting in a complete loss. Another pond at the project was stocked in mid-October with *O. niloticus* juveniles from the Fisheries breeding ponds. A few other individuals from the private sector on the village level have requested

assistance in setting up fish ponds. Fisheries Division, with assistance from SPADP, has initiated a study to assess the potential of Afulilo hydro reservoir for aquaculture, particularly for culturing *O. niloticus*.

### 3). Turtle

The Fisheries Division initiated a turtle hatchery at Malaela, Aleipata in 1970. This was primarily concerned with restocking the hawksbill population by attempting to eliminate the high fatality rate young turtles were presumed to experience during their first few days of life (Banner, 1972). During the lifespan of the project, about 10 years, annual number of turtles released to the sea from the hatchery ranged between 2,000 and 5,300. The project was closed down in 1982 due to economic reasons.

### 4). Baitfish (freshwater mollies)

In 1978, a pilot baitfish culture, raising the freshwater molly, *Poecilia mexicana*, was launched at Vaitoloa with the support of FAO/UNDP. This was an effort to alleviate shortage of wild baitfish for the pole-and-line fishery for skipjack. (The molly is believed to have been originally introduced into Western Samoa around the beginning of the century for mosquito control). Baitfish production level was acceptable but catch rates from fishing expeditions using cultured mollies were not high. Popper (1982) reported that 13 mt of feed produced 5.3 mt of bait. The project was closed down in 1983 as pole-and-line fishing using cultured mollies was not economical.

### 5). Freshwater prawn

Upon request by the Western Samoa Government, experimental cultures of the marine shrimp, *Penaeus monodon*, and the giant Malaysian freshwater prawn, *M. rosenbergii*, were conducted in 1979 with financial and technical assistance of FAO/UNDP. Post-larvae of these species were imported from Tahiti in 1979 and reared to maturity in the brackish-water ponds used for the baitfish culture project. The mature *M. rosenbergii* were successfully propagated at the Fisheries Division laboratory in 1980. This led to the establishment of a hatchery at the Fisheries Division headquarters in Apia. Construction of three earthen ponds at Solaua, for the culture of freshwater prawns, was completed at the end of 1980. The ponds were stocked in November, 1980 using post larvae imported from Tahiti and those produced at the Fisheries Division. Subsequent re-stockings were made solely with post larvae produced from the Fisheries Division hatchery. High growth and survival rates were obtained from initial stockings. However, growth obtained in subsequent re-stockings was slow leading to low production. Problems associated with this included poor pond management and poor quality of feed. The local entrepreneur did not accept the Government's decision to charge post larvae from the hatchery and the project eventually closed down in 1984 even though the Government hatchery was in a position to supply post larvae.

In an effort to assess establishing a cash-generating project for the village community at Lotofanga, the Hanns Seidel Foundation imported 1,000 *M. rosenbergii* post-larvae from (New Zealand?? Fiji?? Tahiti??) at the end of 1990. These were introduced into a natural fresh-water pond, which is fed by a permanent spring, in the village (Zann, 1991). The project was discontinued due mainly to objection from the Environment Unit.

#### 6). Green mussel

Investigation into the culture of the Philippine green mussel, *Perna viridis*, began in 1982 with the importation of mussel spats from CNEXO/AQUACOP, Tahiti. Failure of the initial trials in areas near Apia led to a second importation of spats in February, 1983 (Bell, 1984). These were transplanted into sites in remote areas, Safata Bay on Upolu and Asau Bay on Savai'i. Culture trials in these two sites were very successful in terms of growth rates, meat content and survival, particularly in Asau Bay. Production level obtained at Asau Bay was high and comparable to those obtained in countries where the same mussel species is cultured commercially. SPADP funded a consultancy in 1988 on the Feasibility for Commercialization of Green Mussel Farming in Western Samoa, concentrating on Asau Bay. The main recommendation of the study was to carry out a scaled-up pilot farming programme to confirm the commercial feasibility of the species. However, the 1990 Cyclone Ofa broke off a large portion of the airstrip that acted as a wave barrier and nutrient retainer for the bay and was thus considered to be no longer productive enough. Thus the recommended scale-up project never eventuated. [Fisheries Division will be looking at assessing the current productivity of the bay to confirm potential for aquaculture.]

#### 7). Giant clams

The Fisheries Division's giant clam project was initiated in late 1987 with SPADP funding a 3-week attachment at the MMDC giant clam hatchery in Palau for one of the Fisheries staff. Five hundred *Tridacna derasa* yearlings were imported from MMDC in 1988. With financial assistance from SPADP, the Fisheries Division's giant clam hatchery was started and became operational in mid-1988. Four specimens of *T. squamosa*, collected locally, were successfully spawned in the same year and yielded 8,000 yearlings in the following year. These were used to initiate lagoon nurseries in 3 villages on Upolu Island in 1989. However, all were lost during Cyclone Ofa in 1990. A private company, interested in farming giant clams on a commercial basis, was established in 1989. The company imported juveniles from a private hatchery in Cairns, Australia for its operation. In attempts to establish stocks for aquaculture purposes, fisheries Division/private company initiated several giant clam importations involving three species, *T. derasa*, *T. gigas* and *Hippopus hippopus*, starting in 1990. Due to severe losses during Cyclone Ofa in 1990, and then Cyclone Val in 1991, the 'Giant Clam Rehabilitation Programme' was started and materialized in 1992. The programme, with funding assistance from SPADP, targeted at importing a total of 15,000 clams from Fiji. Using clams from the rehabilitation programme, two lagoon nurseries were initiated on Savai'i Island. One was started at the end of 1994 and the other in May 1995. The private company that was set up in 1989 to commercially culture giant clams seems to have lost interest in giant clam farming due to severe losses during the two cyclones.

#### 8). Pacific oysters

With the assistance of SPADP, the Western Samoa Fisheries Division initiated culture trials of the Pacific oyster, *Crassostrea gigas*, in 1990. A shipment of oyster seeds consisting of 5,000 diploid and 50,000 triploid seeds was received in June, 1990 from the US. These were transplanted to Safata Bay, with some triploid seeds transferred to Namu'a later on. The farm set-up involved a consultant from Kitt's Oysters in Canada. The results indicated that Safata Bay is suitable for oyster culture considering growth rates and meat content attained during the trials. Triploid seed was determined to be superior. Even though high mortalities were experienced and that growth was highly variable, these were attributed mainly to poor management. Three separate harvests were conducted with the first one done 46 weeks after planting. The second was conducted six days after that. These harvests yielded 1,350 triploid oysters and were sold to a local seafood distributor company, SAMPAC, at WSS\$10-per dozen (Winterstein, 1991). The third harvest yielded 1,500 oysters and these were distributed to the public as a consumer-rating survey. Responses from restaurants and other buyers of the harvested oysters indicated that triploid oysters locally cultured were considered superior in flavour and of equivalent flesh size to *C. gigas* imported from New Zealand (Zann, 1991). SAMPAC estimated the Apia market for oysters to be around 50,000 oysters per year. (Further trials are envisaged).

#### 9). Seaweeds

In 1975, seaweeds, *Kappaphycus alvarezii* and *K. denticulatum*, were introduced into Western Samoa. Details surrounding this undertaking is not known.

The Fisheries Division initiated culture trial of *Eucheima* in 1991, using seeds from Fiji. Original sites tested were Mulinu'u and Aleipata. After the initial culture trials, efforts were directed to developing Namu'a, Aleipata for seaweed farming. Grow-out trials at Namu'a indicated that the area was suitable for Eucheima culture. However, Cyclone Val that went through Samoa in 1991 destroyed all planted seaweeds making it impossible for the Fisheries Division to conduct any assessment. (No current plans to revive this project).

#### 10). Freshwater crayfish

A joint venture between a local entrepreneur and an Australian partner initiated the culture of freshwater crayfish, the Australian redclaw (*Cherax quadricarinatus*) and the yabby, (*C. destructor*) in 1993. Animals of various sizes of both species were introduced from Australia and cultured in earthen ponds at Solaua which were used in the freshwater prawn culture project in the early 1980s. This effort was disrupted by the sudden "disappearance" of the Australian partner. In a more "genuine" effort to establish the potential of farming freshwater crayfish in Western Samoa, a shipment of *C. quadricarinatus* juveniles was imported in early 1995 with the operation under a different manager and the same local partner.

#### 5. Impact of Aquaculture Development in Western Samoa.

Tilapia introduced back in the 1950's has lead to the establishment of a catch tilapia fishery in at least 2 villages on Savai'i and 3 on Upolu. The natural brackish-water pond in the village of Sato'alepai, Savai'i was one of those stocked with tilapia in the late 1950's and early 1960's. At present, the villages of Sato'alepai and Savai'i continue to fish for tilapia from within the pond, almost on a daily basis. One family in the area uses fishing nets while the rest uses lines. On Upolu, people of Sogi, Vaitoloa and Vaimoso also occasionally fish for tilapia.

In terms of economic returns, aquaculture development in Western Samoa has not yet reached the level of commercialization. Attempts have been made with farming the freshwater prawns and currently the fresh-water crayfish on a semi-commercial level. These ventures involve the private sector. Results from culture trials of green mussel and Pacific oyster indicate the potential of sites chosen for the culture of these species. However, scale-up setups need to be conducted to properly assess the economic viability of such undertakings.

Development of small-scale backyard aquaculture is seen as one of the potential means of diverting fishing efforts away from the over-fished reef and lagoon fishery resources. Additionally, this can create a source of protein as well as supplementing income if properly developed and sufficiently supported. Accordingly, government efforts are directed towards this area, using mainly the tilapia, *O. niloticus*. A tilapia taste test survey conducted in 1995 using tilapia imported from Fiji, with financial assistance of SPADP, indicated that the majority of responses (66 per cent) considered tilapia to taste better than reef fish (Ropeti, 1995). Twenty nine per cent of the responses considered tilapia as having the same taste as reef fish while only 5 per cent considered tilapia as having an inferior taste to that of reef fish. However, in terms of selling value, the opposite trend was recorded where the majority (62 per cent) of the responses considered the Israel tilapia to be sold cheaper than reef. Twenty nine per cent considered tilapia to be sold at the same price as reef fish while 14 per cent assessed it as more expensive than reef fish. The main aim of efforts to assess the potential of the Afulilo reservoir as an aquaculture site is to create a main alternative source of fish.

The possibility of reseeded depleted stocks and enhancing reef resources can be made possible through aquaculture, especially giant clams, and cautious introduction of selective exotic species such as *T. niloticus*.

#### 6. What is needed for Western Samoa's Aquaculture Development.

Aquaculture is a new technology to Samoans. Accordingly, general experience and technical know-how is virtually nonexistent in the public sector. Training in basic pond operation and management as well as aquaculture principles are of vital importance to the development of aquaculture in the country. Even though efforts have been directed to the development of aquaculture in the country, relative budgetary allocations have always been minimal. This is a result of economic constraints that is always faced in island situation. Priority is always given to areas when quick economic returns can be readily recognized. In addition, government allocations seem to be directed towards "traditional" projects that had been in existence and that addition of any new project is very difficult to go through for local funding support. This has resulted in a situation where aquaculture research and development are heavily dependent on available financial assistance from outside which is also not readily available.

Shortage of staff, especially qualified staff, and lack of infrastructural support, e.g. transport, have always played a major set-back in aquaculture research.

#### 7. Species considered for future Aquaculture Development.

Fisheries Division is looking at re-visiting some of the aquaculture areas using species already tried, e.g. Pacific oyster, green mussel and giant clams. This will depend on financial assistance and manpower available as well as the availability of seeds and practicality of shipment. Possible new species for future aquaculture consideration include *Trochus niloticus* and pearl oysters.

#### 8. Additional topics for discussion.

*Information dissemination* : With the exception of a few countries, there is a general lack of update information received, and in certain occasion, on a timely basis, by South Pacific aquaculture researchers on studies conducted outside the region. While most of the journals are extremely expensive and far too academic in nature for our purposes, there are some newsletters, especially those from Asia, e.g. Aqua Farm News and SEAFDEC Asian Aquaculture, that are worth acquiring for distribution.

*Information exchange* : There is very little exchange of information amongst Pacific countries on aquaculture research and development. Mechanisms need to be developed to facilitate this important activity. One such mechanism is the establishment of sessions which can be discussed over PSAT. Perhaps SPADP can facilitate such sessions on topics of relevance to the region or sub-region. Another component of this exchange of information is the aspect of improving report writing and publication of technical papers. Most, if not all, of the scientific/aquaculture journals demand a high level of writing skills in order for an article to be published. However, establishing a means that can suit our needs can be developed. This can include: (1) encouragement to publish information in the SPC Newsletter; (2) development of an "Aquaculture Interest Group" Newsletter as discussed in the first SPADP (Phase II) Technical Meeting in Suva (SPC/SPADP); and (3) ICLARM and JICA/Ministry of Fisheries, Tonga, to accommodate publishing technical papers from other South Pacific countries in their newsletter.

*Protocol on the introduction and translocation of species* : Even though aquaculture and introduction of exotic species both for aquaculture and resource enhancement purposes will continue to be part of aquaculture research and development, concerns are mounting over irresponsible introductions and translocation of live animals without taking necessary precautions on the possibility of diseases introductions and detrimental genetic mix-up. There needs to be cooperation amongst countries in facilitating a mechanism ensuring that necessary precautions are fulfilled by both the exporting and importing countries. Accordingly, development of a protocol outlining each sides responsibility is worth looking into.

*Funding sources* : As was said before, aquaculture research and development will tend to rely heavily on financial assistance from outside. But apart from the traditional funding agencies, there are probably a host of other funding sources which can be tapped but unknown to the aquaculture researchers.

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