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RESEARCH REPORTS IN THE ECONOMICS OF GIANT CLAM MARICULTURE

Working Paper No. 38

**Business Strategies for the Growing of Giant
Clams: What Paths Have Been or Are Being
Followed by Enterprises?**

by

**Clem Tisdell
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Bruce Stevens**

April 1993



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By

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Jeremy Barker³

Bruce Stevens³

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Research for the project *Economics of Giant Clam Mariculture* (Project 8823) is sponsored by the Australian Centre for International Agricultural Research (ACIAR), G.P.O. Box 1571, Canberra, A.C.T. 2601, Australia. The following is a brief outline of the Project:

The technical feasibility of culturing giant clams for food and for restocking tropical reefs was established in an earlier ACIAR project. This project is studying the economics of giant clam mariculture, to determine the potential for an industry. Researchers will evaluate international trade statistics on giant clams, establish whether there is a substantial market for them and where the major overseas markets would be. They will determine the industry prospects for Australia, New Zealand and South Pacific countries, and which countries have property right factors that are most favourable for commercial-scale giant clam mariculture. Estimates will be made of production/cost functions intrinsic in both the nursery and growth phases of clam mariculture, with special attention to such factors as economies of scale and sensitivity of production levels to market prices.

Commissioned Organization: University of Queensland.

Collaborators: James Cook University, Townsville, Queensland; South Pacific Trade Commission, Australia; Ministry of Primary Industries, Fiji; Ministry of Natural Resources and Development, Kiribati; Silliman University, Philippines; Ministry of Agriculture, Fisheries and Forests, Tonga; Forum Fisheries Agency, South Pacific; ICLARM, Manila, Philippines.

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Business Strategies for the Growing of Giant Clams: What Paths Have Been or Are Being Followed By Enterprises?

ABSTRACT

Outlines development strategies of firms which have engaged in giant clam mariculture, particularly Australian firms, with special attention being given to Reefarm Pty. Ltd., the longest surviving commercial company involved in giant clam mariculture. Considers methods which companies in this area have used for coping with business uncertainty; examines the development of Reefarm Pty. Ltd and the choice of product-mix by Reefarm. The product mix involves pearl oysters, and supply of giant clams for a variety of markets (the aquarium trade, seed sales, the restaurant trade for food and provision of tourism/educational services). The analysis indicates the importance of considering the development of firms from an evolutionary perspective.

Keywords: giant clam mariculture in Australia, business uncertainty, restaurant trade, tourism.

JEL Classifications: Q57, Q21, Q22

Business Strategies for the Growing of Giant Clams: What Paths Have Been or Are Being Followed By Enterprises?

1. Introduction and Background

Commencing any new business venture is always a risky enterprise. This is even more so when a new product is to be produced for which production techniques are new and evolving and markets are only partially or incompletely established. Enterprises embarking on the commercial mariculture of giant clams (*Tridacnids*) have had to contend with the latter situation. In the last decade, techniques for the mariculture of giant clams have been evolving and, in most developed countries, markets for giant clams have been very limited, for example mostly to their sales as aquarium specimens or to the sale of their shells collected from the wild and in a few places, such as Okinawa, to their sale for food. Commercial farming of giant clams has required the establishment of market structures to take care of the farmed product.

Despite the above risks and difficulties, several enterprises have embarked on the commercial growing of giant clams. It is worthwhile considering the business strategies which they have employed. In this study the main focus will be on Reefarm Pty Ltd., the longest surviving commercial farm involved in giant clam farming – an enterprise which it embarked on in 1984. It operates a land-based marine hatchery and growing facilities on Fitzroy Island near Cairns. It was started by a small group of Cairns businessmen but today, Bruce Stevens is the only remaining shareholder from the original group. The company continues to produce giant clams commercially.

Other Australian ventures have tried giant clams. Pacific Clams Ltd was formed for this purpose and managed by Bruce Marcum. Its headquarters were also in the Cairns area. Its aim was to engage in entirely marine-based aquaculture of giant clams using floating pontoons and platforms. It secured a small marine lease off Fitzroy Island and also had a lease at Sudbury Reef. Its approach to the farming of giant clams was highly experimental/innovative and considerable investment in capital for its structures was required. It went into liquidation before it was able to achieve significant production and

sales, partly because of cash flow problems and the destructive impact of a cyclone on its marine-based facilities. It concentrated on the production of *T. gigas*. It seems that the market for its product was very uncertain.

In 1986 Seafarm Ltd was operating saltwater land-based aquaculture facilities near Innisfail. Its prime purpose was to produce seed prawns but it also held some giant clams Dr Rick Braley was there. This facility was struck by a cyclone which caused considerable damage including destruction of many circular corrugated iron pools containing giant clams. Remaining giant clams were transferred to Orpheus Island when Dr Rick Braley joined the ACIAR Giant Clam Project there. So Seafarm Ltd. never actually embarked on the process of using its giant clams commercially. ·

It was also reported that Kaillis Brothers experimented for a short time with the possible culture of giant clams in the Gulf of Carpentaria. Juvenile clams were sent from Orpheus Island near Townsville but the temperature of the waters of the Gulf was too hot in the summer for these juvenile giant clams to survive. However, giant clams do exist in the Gulf and if local animals are used as broodstock they may be more likely to survive.

In 1989, W.A. Clams made an application to the Fisheries Department of Western Australia for a licence to mariculture giant clams of the species *Tridacna gigas* in Exmouth Gulf using a land based hatchery and adjacent growout area. While we lack information on how that application/venture fared, it is interesting to observe from the application for the licence, the paucity of information which the principals of the proposed venture appeared to have had about the market for their product. They said, in the application (p.2), 'It is proposed to market the product in Southeast Asia. Definite plans are not presently available but enquiries are underway. The present illegal operation of Taiwanese clam boats indicates the strong demand for the product, as does the expansion into clam mariculture in the Pacific. It will be at least three years from the commencement of this project until harvesting, thus, sufficient time is available for market development.'

Like many other enterprises, W.A. Clams seemed prepared to make a substantial capital outlay before determining the market for its product, the cost of developing this market and the expenses of delivering and distributing its product to market generally.

Mention might also be made of James Cook University's efforts to establish a joint commercial venture to mariculture giant clams. In 1989, James Cook University advertised

for a joint venture partner, and an agreement was signed with a company controlled by David Clark, a Queensland businessman. An economic feasibility study financed by David Clark's company was to be undertaken and if the venture appeared to be economically feasible, James Cook University was to receive a 12½% shareholding in the joint venture company *gratis* for its assistance. Financial constraints resulting from the economic recession, however, meant that David Clark's company could not continue with this joint venture development and another partner was found. The final outcome, however, was that the venture did not proceed.

Outside Australia, commercial enterprises for the growing of giant clams exist in the Marshall Islands and in Samoa. The farm operating in the Marshall Islands is reported to be facing financial difficulties for a number of reasons. These include:

- 1) The fact that the Marshall Islands is not a signatory to CITES making it difficult to export the product of the farm.
- 2) The farm is located on an island to which transport is difficult. This apart from adding to shipping and other costs, means that the facility cannot be used as a tourist attraction.
- 3) *T. gigas* is being grown and this species may not be best for tapping existing markets for giant clams, e.g. the market for aquarium specimens.

The Micronesian Mariculture Demonstration Center (MMDC), Palau, has a long history of involvement in the aquaculture of giant clams. It has gone from a facility virtually completely dependent on government funding (much of which was supplied through United States aid) to one which must generate a substantial amount of its own revenue. As a result its giant clam operations have had to be commercialised. It earns revenue through:

- 1) The sales of giant clams as aquarium specimens.
- 2) Fees charged for tourist visits.
- 3) Sales to tourists of souvenir items relating to giant clams, e.g. shells, shell lights, etc.
- 4) Sales of giant clams for meat to local restaurants in particular.
- 5) Sales of seed clams.
- 6) Fees for training individuals in the techniques of giant clam farming.

It therefore has a relatively diversified market for its clams.

It has been reported (pers. comm. J. Heslinga, June, 1992) that a new giant clam farm is to be established in Palau. This is to be entirely commercial and is planned to be the world's largest giant clam farm. We have no knowledge of the business strategy that it plans to adopt.

2. Coping with Uncertainty in Business

Since embarking on giant clam farming in the early phases of the development of this industry is clearly a risky and uncertain enterprise, it may be useful to review some of the general means which firms use to cope with business uncertainty. These include:

- 1) Information gathering and learning.
- 2) Experimenting continuously on a small scale e.g. by trial-and-error.
- 3) Diversifying in terms of the range of products produced and in relation to markets served.
- 4) Ensuring that equipment and techniques adopted have multiple uses. This aspect involves making sure that equipment is flexible or adaptable in use. It will be more flexible if it can be easily used for producing a number of different products.
- 5) Risks may also be reduced for individuals by ensuring that the venture is based upon the participation of a large number of individuals each holding a small proportion of the capital of the business as in a joint stock company.
- 6) Risks may also be reduced by ensuring that the non-escapable and/or possible sunk costs of the venture are low. For example, less durable equipment than is likely to be optimal if the venture is proven viable, may be installed initially if this equipment is cheaper. If the venture is not a success the loss on this equipment may be smaller. Or again, where possible it may be preferable to rent or hire equipment or lease rather than purchase it initially,

While some of the firms embarking on the mariculture of giant clams, seem to have taken some account of these principles many did not. For example, Pacific Clams Ltd invested heavily in equipment with a specific purpose - namely for the ocean-based cultivation of giant clams. Thus a large sunk cost was incurred. Its equipment was not flexible and adaptable to other uses. Furthermore, it adopted in a non-incremental manner unproven

experimental methods of production. It failed. Conceivably, the theories of its managers could have worked out, but since they did not in practice, the company faced a substantial loss. It seems also that Pacific Clam Ltd; was not very diversified, nor very sure of its markets. As observed earlier, W.A. Clams had very little market knowledge, but was still prepared to take a risk and go ahead with its investment it seemed.

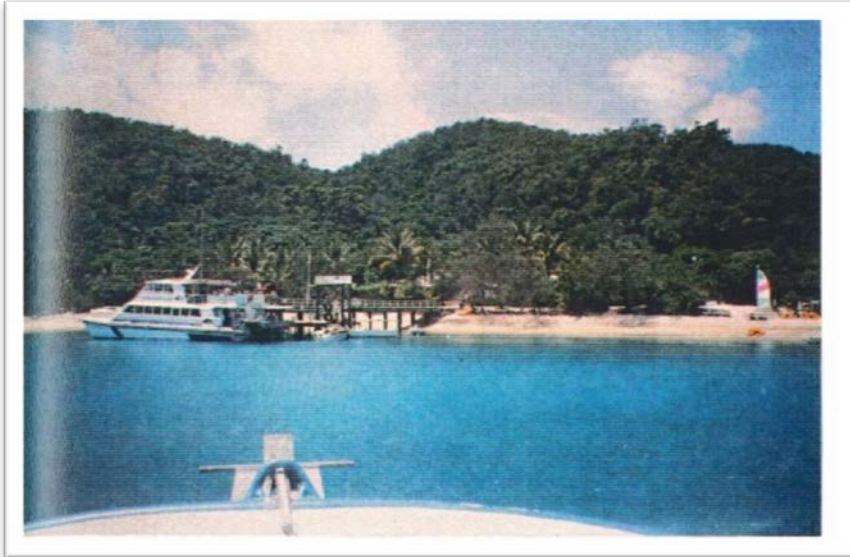
In the light of the above, it is useful to consider the approach taken by Reefarm Pty Ltd - the longest surviving commercial enterprise involved in giant clam mariculture.

3. Some Background on Reefarm

Reefarm Pty Ltd is a relatively small business which operates a marine hatchery/nursery at Fitzroy Island. It was founded by a group of Cairns businessmen. Due to unforeseen circumstances two of the original principals are no longer involved with the company so Bruce Stevens is the only remaining principal. It is now essential for the firm to obtain a satisfactory cash flow since means for covering its deficits have become limited.

The manager says that the main aim of the company is to realise a profit. Recent developments such as tourism and the production of the seed of South Sea pearl oysters have been an important means of adding to the company's cash flow. Although the mariculture of giant clams is less profitable than that of pearl oysters, Reefarm expects to continue producing giant clams for the reasons to be discussed below. This production will continue to be restricted to land-based operations unless extra (venture) capital is injected into the company from outside e.g. through the formation of a joint venture to make use of its Arlington Reef lease. Since its inception, Reefarm has concentrated on land-based mariculture (in contrast to Pacific Clams) even though it has a lease on Arlington Reef which makes growout of giant clams possible.

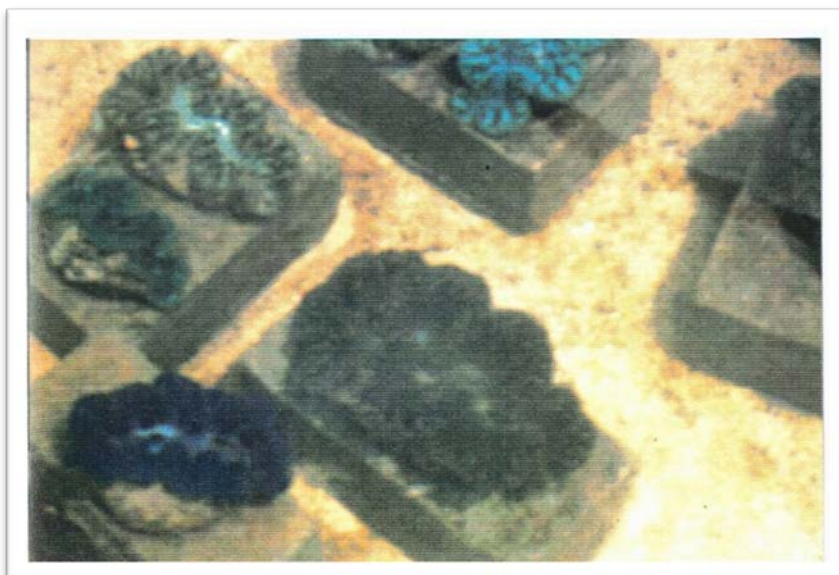
At its Fitzroy Island site (see photographs 1 - 3), Reefarm has cultured species other than those now being cultured, namely giant clams and South Sea pearl oysters. In the past these have included prawns and barramundi but these are no longer being produced. Most growers of barramundi in the region, mainly cane farmers, now breed their own barramundi so insufficient demand exists for hatchery supply of barramundi fingerlings. Clearly the company has *explored* a number of commercial possibilities in the past and tried these. Search and exploration have been an important part of its business behaviour.



Photograph 1:
Jetty at Fitzroy
Island



Photograph 2:
An overview of
tanks at Reefarm on
Fitzroy Island



Photograph 3:
T. crocea and *T.*
maxima broodstock
at Reefarm

It has also engaged in experimental behaviour to increase its yields from giant clam mariculture. An earlier manager of the aquaculture facility, Philippe D'Or experimented with the addition of fertiliser to tanks so as to enhance the growth rate of giant clams; Reefarm was one of the earliest organizations to use fertiliser for this purpose, even though at that time the most effective ingredient had not been identified. Now ammonium based agents are known to be the most effective growth-enhancing agents.

In addition, macroalgal bloom in tanks was a problem. Phillippe D'Or found that amphipods were effective grazers on the algae. This was an important discovery for Reefarm making the holding of giant clams in land-based tanks practical over a long period of time. But as with many discoveries, it was, to a large extent, a chance discovery.

Another 'chance' event which has recently benefited Reefarm has been the growth of tourism to Fitzroy Island. The extent of this growth was probably not fully anticipated at the time of establishment of Reefarm. The Daikyo tourist development on the island has been a factor encouraging this growth. Tourist visits to Reefarm's facilities have now become an important revenue earner for the company. Management believes that up to 100 tourists per day could visit Reefarm's facilities, especially if this visit becomes part of the tour package offered by "Sunlover Cruises" and "Great Adventures".

It can be seen that exploratory, trial-and-error behaviour have influenced the development of Reefarm. The company has tried exploratory (trial-and-error) behaviour in its search for profitable possibilities which if discovered can become routine, if the outside world does not change too rapidly. Its behaviour is rather different to that suggested by static models in microeconomic textbooks.

Since inception (up to the end of 1992) Reefarm had not operated profitably and had encountered cash flow problems. To improve the profitability of its operations, it commenced production of South Sea pearl oysters in 1991 and in July 1992 embarked on the use of tourist visits to the hatchery/aquarium as a means of generating revenue. These activities were added to its activities involving the rearing of giant clams. The giant clam species being cultured are (1) *Tridacna crocea*, (2) *Tridacna maxima* and (3) *Tridacna gigas*. Thus basically three main commodities are being produced at Reefarm: (1) giant clams, (2) South Sea pearl oysters and (3) aquarium-based tourism services.

Three to four people are employed at Reefarm (November, 1992). Three are concerned

entirely with aquaculture facilities whereas the fourth person mainly acts as a tourist guide.

The land area available to Reefarm at Fitzroy Island is relatively small but at present is not fully utilized. Only about half of the area available for growout tanks is used at present. The company could achieve economies of scale if it could utilize all the space for holding tanks. Depending upon the demand for its products, the company plans to expand the number of its tanks, all of which are made of fibreglass. These are considered to be much better than splashers pools with polythene liners because they are more durable.

Reefarm has a small marine lease at Fitzroy Island. However, it has a lease of 67 hectares on Arlington Reef, some considerable distance from Fitzroy Island. This was intended for the growout of *Tridacna gigas* and *Tridacna crocea* but because of cash constraints and other limitations (particularly the absence of readily accessible markets for clams for food) it has not been developed for commercial use. In order to fully develop it, it is estimated that a cash investment of about \$A1 million would be required and this could only be considered by Reefarm if a joint venture were prepared to contribute most of this capital. The reef is distant from Cairns and since there is no land in the area a platform would have to be built for servicing the growout farm.

Let us consider the various commodities being produced by Reefarm as at November, 1992.

4. Pearl Oysters

In order to diversify and generate cash, Reefarm began producing South Sea pearl oysters in 1991; (see photograph 8). The oyster seed are sold at 3-4 months of age at \$A1.00 each to farmers culturing pearls. Cash is generated quickly and the production of sea pearl oysters is much more profitable than that of giant clams;

The same types of tanks used for rearing giant clams can also be used for rearing pearl oysters. However, while giant clams must have access to sunlight, oysters can be placed in multi-layered tiers in the tank. They therefore make more intensive use of available space, even though separate algal tanks must be kept in order to supply the young oysters with food.

While the production of pearl oysters is potentially much more profitable than giant clams; the market for the juveniles is limited because the company can only sell to registered pearl oyster farmers in Queensland. Interstate movement of pearl oysters is limited because of the

risks of diseases and pests being spread.

White and gold-lipped oysters are endemic to Australia and produce the highest quality pearls in the world. Black-lipped oysters produce black to grey pearls and research is being undertaken into the mariculture of these. Black-lipped pearl oysters provide the basis for a \$40 million industry in French Polynesia.

The international market for pearls has been controlled by the Japanese, even though a few Australian producers now sell directly to the USA. Western Australia is Australia's major producer of cultured pearls and in general has cooperated in cartel arrangements to restrict the supply of pearls.

Because pearl oysters can now be produced by hatcheries, it has been suggested that this may lead to an increase in the supply of pearls and a fall in their price. However, this may not happen. Demand for pearls may increase because a number of countries in Asia are experiencing economic development. Furthermore, hatcheries may enable the quality of pearls to be improved and this may result in some increase in demand.

In any case, it may be counterproductive for the Australian pearl oyster industry to prevent or hinder the introduction of pearl oyster hatcheries in Australia. Indonesia is interested in hatchery produced pearl oysters and unless Australia moves into this activity it could lose out to Indonesia. Australia should be able to compete with Indonesia by better quality control enabling a superior product to be produced.

No hatcheries, other than Reefarm, exist for breeding South Sea pearl oysters on the east coast of Australia and in 1992, Reefarm made a major effort to increase its production. While a hatchery exists in Darwin and another in Broome, these are only allowed to supply local areas because of the risk of the spread of diseases and pests. The Queensland Department of Primary Industries has placed a moratorium upon the establishment of new pearl farms and pearl oyster hatcheries in Queensland pending the outcome of its investigation of the industry. So at this time, entry into the breeding of pearl oysters is restricted and the market for seed is also restricted.

5. Giant Clams at Reefarm

As mentioned earlier, Reefarm is producing three species of giant clams - *T. crocea* and *T.*

maxima for the aquarium trade and some *T. gigas* are also produced. Let us consider its supplies for different markets.

5.1 Sales to the Aquarium Market

Giant clams are held for about two years to satisfy the aquarium trade. Mostly *T. crocea* and *T. maxima* are used for this purpose (see photograph 3). At this age, they are 5-6 cm, in width and *T. crocea* sell for \$A5.50 each and *T. maxima* for \$A6.50 each. A premium of \$A1.00 each may be paid for brightly coloured *T. maxima*. *T. maxima* are slightly larger in size than *T. crocea* after two- three years of growth. In addition, Reefarm is able to selectively breed *T. maxima* so as to obtain specimens with desirable bright colours.

Reefarm still continues to rear some *T. gigas* not only for historical reasons but also to keep its options open. Most aquarium wholesalers ask for some *T. gigas* to be included in their order.

Despite the licensing requirements of the Queensland Department of Primary Industry, which hampers sales of giant clams as aquarium specimens in Queensland, Reefarm reports that it continues to make some sales in Queensland to the aquarium trade, even though most Australian sales are to other states. It makes its international sales through a Cairns wholesaler of aquarium specimens and its international sales are rising.

As can be seen, Reefarm keeps a variety of species of giant clams to satisfy the aquarium trade. This is because it wants to spread its risk and the aquarium dealers appear to demand mixed batches of clams.

5.2 Sales to Scientific Institutions

Some sales of giant clams can possibly be made as specimens for use in scientific institutions.

5.3 Sales of Giant Clam as Seed for Culture

The company has not concentrated on the supply of giant, clam seed. However, some orders have been received from overseas for *T. gigas* seed. An order for 100,000 seeds has been received from an Australian/Indonesian joint venture planning to farm giant clams in West Timor, and a possible order for seed has been received from Cocos Island. Reefarm is willing to supply seed of three months old at \$A0.25 each or one year old at \$A1.20 each.

Reefarm would like to dispose of its seed in the earliest stage possible. This would optimise their use of facilities and access to broodstock. The company is willing to produce seed to order.

5.4 Sales to the Restaurant Trade and for Food

Regarding sales of giant clam meat to the local restaurant trade, Reefarm has been disappointed by the response. While a small amount of meat has been introduced to restaurants in Cairns, the main problem encountered was that most chefs did not know how to prepare it. This included Japanese restaurants. Furthermore, most chefs seemed to require a slightly larger sized clam than those of 5-6 cms produced by Reefarm for the aquarium trade.

No one is currently buying giant clams from Reefarm for the restaurant trade. However, Reefarm could currently supply two or three restaurants on a regular basis. Some interest has been expressed from Japan in buying 5-6 cms *T. crocea* to supply the food market. The best Japanese offer received so far has been ¥13,000 per kg. in the shell delivered. For 5-6 cm clams, this works out at about A\$2.50 per clam delivered. For regular contracts for clams for food, Reefarm may be prepared to accept A\$2.50 at the farmgate. The best price offered so far by Australian restaurants is \$1.50 per clam.

A major inquiry was also received from Singapore for supplies for the food trade. The prospective purchaser wanted to buy 20,000 giant clams, but Reefarm could only offer 5,000 and still meet the demands of its regular customers.

Given its current scale of operations, the cost of producing two-to-three year old giant clams is possibly too high for Reefarm to be able to supply the restaurant trade even if chefs could use giant clam meat effectively. Only if its volume of production were substantially raised would Reefarm be able to lower the price for its giant clams substantially and be in a better position to meet demand from the restaurant trade. Substantial economies of scale exist in the growing of giant clams in land-based facilities (cf. Tisdell et al., 1993).

6. Tourism, Giant Clams and The Nursery

In October 1992, Reefarm began using its nursery as a tourist attraction (see photographs 4-7). The additional cost of doing this was moderate. It involved the installation of touch tanks, a loudspeaker system and the provision of some chairs. The visit takes about one hour during

which time a guide gives a presentation.

In November/December the guide was employed on a short-term contract. In the future, however, it was anticipated that the tour guide would be hired on a casual basis from a Cairns company in 1993. It was anticipated that the guide would travel daily to the island by the regular ferry to conduct the tours. In fact, it is reported that the staffing for the tours in early 1993 is one full-time tourism manager, one full-time presenter with a junior assistant, all employed by Reefarm on casual rates.

As at the end of 1992, Reefarm was charging \$A5.00 per visit with concessions for families. On average 35 visitors per day were being received. This is still only a small share of the total number of visitors to Fitzroy Island. It is estimated that Fitzroy Island receives on average about 250 visitors per day for about 200 days of the year.

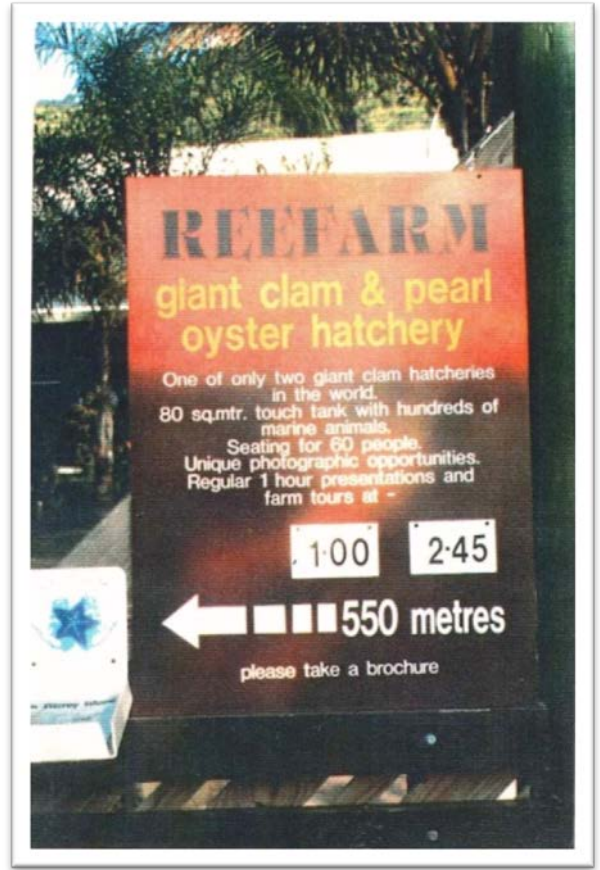
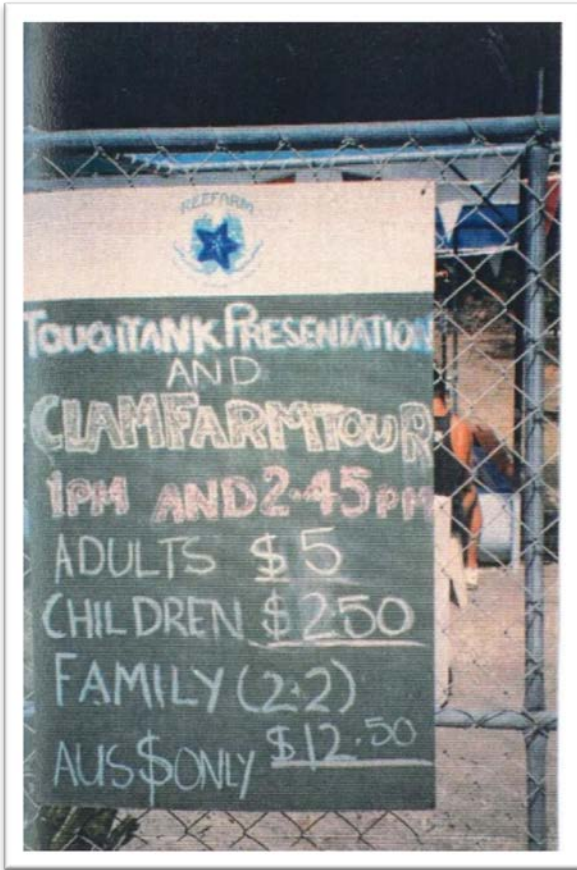
Currently gross receipts from tourist visits are running at about \$A100+ per day. However, there appears to be scope for raising this sum. An entry fee of \$A5.00 is considered to be low. It probably could be doubled without appreciably reducing the demand for visits. Also it may be possible to increase the proportion of visitors to the Island who visit Reefarm. For example, if the ferryboat operators to the island were to promote a visit to the clam nursery, this would increase the number of visitors to Reefarm. There is a possibility of this happening.

Visits to the Giant Clam Hatchery have been advertised in the following way:

'Fitzroy Island, close to Cairns, famous for its rainforest, fringing reef and lighthouse now has a new attraction for visitors.

The Reefarm, Giant Clam Farm Hatchery which has operated for eight years has opened its doors to the public. Reefarm is one of only two clam hatcheries in the world and now successfully breeding South Sea pearl oysters.

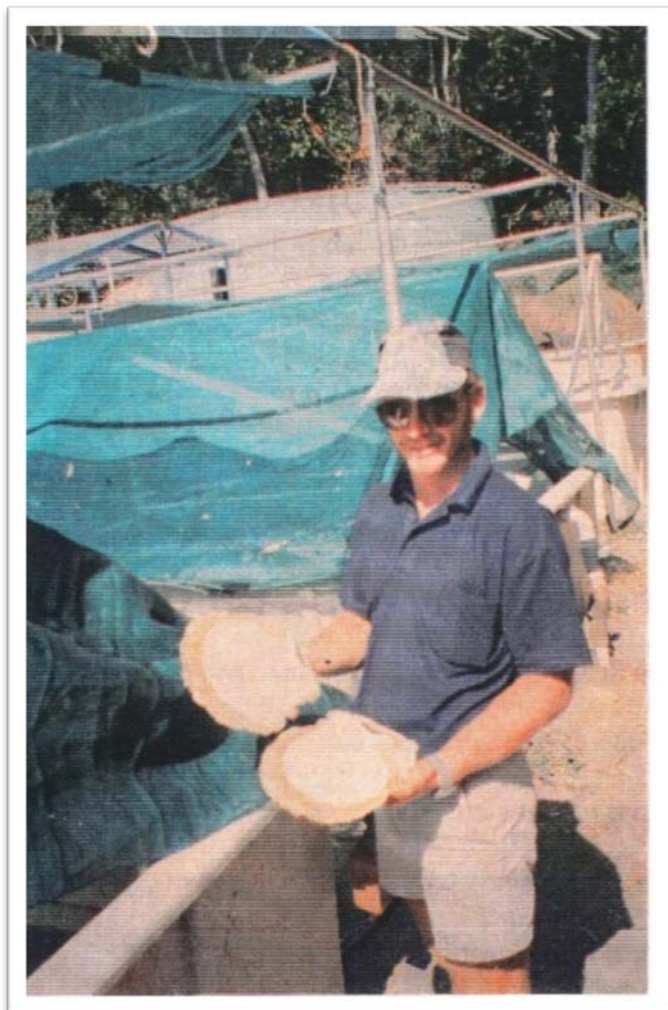
Thousands of the hatchery bred clams, live corals and other reef animals are housed in an 18 metre touch pool with seating for 65 people. The animals enjoy the environment free of their natural predators with constantly changing seawater from the half million litres which passes through the hatchery daily.' (*About Cairns and the Tropical Far North*, October-December, 1992, p. 16).



Photographs 4, 5 and 6: Advertisements on Fitzroy Island to encourage tourists to visit Reefarm



Photograph 7: Tourists attending a touch tank presentation at Reefarm



Photograph 8

Mr Jeremy Barker, manager of Reefarm holding the shells of South Sea pearl oysters, which are now being bred at Reefarm. The heavy shade cloth in the background is used to exclude light from tanks containing juvenile pearl oysters. This reduces algal bloom which can otherwise be a problem. Unlike giant clams, pearl oysters do not require sunlight for their survival.

The addition of tourism visits as an extra revenue earner for the nursery seems to be a profitable development. It is a good cash earner with further potential for growth. It has required little extra expenditure and to a large extent makes use of existing facilities. However, it would seem essential to keep the production side of the nursery/farm operational because a part of the tourist attraction is that it is involved in commercial production of giant clams. As yet, there has been no development of tourist souvenirs for sale but this may be a future possibility, e.g. drawing on items made from giant clam shells (small ones can be dipped in metal) or involving pearls.

7. Reefarm's Development Policy and More on its Tourism/Education Objectives

This section summarises the development policy of Reefarm as basically seen by its Director and principal shareholder, Mr. Bruce Stevens. According to Mr. Stevens, Reefarm's development philosophy is entirely based on the "development of market-driven production" because there is no point in producing large quantities of product unless it is required by the market.

Reefarm's approach to developing giant clam production has been to produce a limited amount of product to enable it to test the market in southern Japan and Taiwan. If a favourable response is received from these markets, then Reefarm would look for a joint venture partner involved in seafood distribution in southern Japan or Taiwan to support financially the commercialisation and expansion of Reefarm's production unit in the Cairns area. Therefore it has a long-term aim to export giant clams for food to the northeast Asian region if markets can be tapped economically. Meanwhile, Reefarm has concentrated on hatchery production and small-scale growout of giant clams, and supply of alternative products. Reefarm commissioned a market consultant in the early stages of its development to assess the potential for sales of giant clams. The confidential findings of the consultant suggested that a large food market for clam meat exists in southern Japan (Okinawa).

The market-driven, cautious, exploratory approach of Reefarm has been a conscious choice by its management. It involves the following ingredients:

- 1) The company proving that it can produce a product before attempting to produce on a large scale, borrowing heavily to do so and involving many shareholders.

- 2) Allowing time for full assessment of market requirements relying on production of a limited quantity of product.
- 3) Acting prudently so that the company does not commit itself beyond a level which may exceed its financial base and result in bankruptcy or takeover.
- 4) Maintaining a degree of flexibility in the company's production. If clams are uneconomic then perhaps pearl shell, tourism/education or other hatchery products may eventually form the "core business" of the hatchery.

Tourism/education was a part of Reefarm's activities in its early days. The company began operations on Fitzroy Island in July 1984 and established a pilot hatchery on the site which now belongs to Fitzroy Island Resort. Tours were conducted through the pilot hatchery but when the hatchery was moved to a new site on the island, tours were discontinued. However, Reefarm began catering for school groups in marine studies at its new site in 1990. In 1990, 30 school groups visited and this increased to 55 groups in 1991.

At the end of 1991, the company adopted the idea of offering a substantial educational/tour programme relying on dedicated staff. This required the conversion of one of the large tanks into a touch tank and required it to be well stocked with a suite of reef animals, corals and a variety of clams. Beginning in July 1992, a complete educational presentation of one hour is offered daily. On average, 35 people have attended daily since the presentation has become available.

An all-inclusive tour including Reefarm is now becoming available through buying ferry tickets for tours to Fitzroy Island, the two island tour (Green plus Fitzroy Island) and Moon Reef. Reefarm expects that its daily visitation rate will increase to 100 – 150 tourists daily. An expanded exhibition and presentation will allow the entrance fee to be raised to \$8.00 per adult. According to Mr. Stevens, this planned development will enable Reefarm to realise an opportunity which was foreseen by the founders of Reefarm when they first applied for a site on Fitzroy Island.

8. Comments on Strategy and Bureaucratic Impediments

While Reefarm has adopted an exploratory approach, it has been relatively cautious in its development. The techniques which it used were in the main already tried elsewhere and found to work e.g. the land-based facilities of James Cook University at Orpheus Island. It

also tended to tap established markets. In particular it has relied heavily on sales to the aquarium trade of giant clams. Distribution networks are already well established for the sale of aquarium specimens and it was able to plug into existing networks. Sale of giant clam seed is, however, more irregular and no established readily accessible marketing network for the sale of giant clams as food for use in restaurants seems to exist. This, combined with the current relatively high price of small clams in relation to the amount of meat supplied, as well as the unfamiliarity of most chefs with this product, means that this is a difficult market to develop.

In the development of its nursery/farm, Reefarm has tried to maintain flexibility. Most of its equipment can be used for culturing species other than giant clams. It is, for example, currently cultivating South Sea pearl oyster seed in tanks which could also be used for giant clams. None of its equipment is as highly specialised as was much of that manufactured by Pacific Clams for its own use.

Reefarm has also attempted to maintain some diversification in the products produced by it at the nursery/farm. Furthermore, in the case of giant clams, its policy has been to produce a range of species. Once again this represents some diversification. Reefarm has therefore used a number of the strategies mentioned in section 2 for reducing its business risk.

Entry into a new industry or business always involves unanticipated difficulties, but these appear to be greatly increased by 'red tape' and bureaucratic controls. Reefarm has to deal with as many as 14 public authorities per year and obtain many permits. This involves both time and cost.

9. Concluding Comments

Few firms that have been entirely commercial since their inception have continued to be involved in the culture of giant clams. However, Reefarm is one such firm. Other firms have entered or have planned to enter the industry with different production strategies and/or markets in mind to those used by Reefarm. For example, Pacific Clams attempted to implement a radically different technique of producing giant clams. It seemed also that many firms who enter the industry do so with little knowledge of market and economic possibilities. A relatively diverse range of strategies have, therefore, been tried. Evolutionary economists argue that this tends to be typical of a newly emerging industry and that

behaviour is typified more by trial-and-error procedures than by optimising (Metcalf and Gibbons, 1989). It is possible that some of the enterprises that failed could have succeeded but without actual attempts, it may be difficult to separate winners and losers. Progress initially involves winners and losers. Errors are also an important part of learning. Nevertheless, this should not be interpreted as support for foolhardy trials or for those enterprises which do not take reasonable steps to cover themselves and their shareholders against risk and uncertainty.

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