

RESEARCH REPORTS IN THE ECONOMICS OF GIANT CLAM MARICULTURE

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Giant Clams in Tuvalu: Prospects for
Development

by

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Giant Clams in Tuvalu: Prospects for Development¹

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Luca Tacconi and Clem Tisdell²

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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.

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GIANT CLAM CULTURE IN TUVALU: PROSPECTS FOR DEVELOPMENT

ABSTRACT

The prospects of giant clam culture in Tuvalu are examined. Sea resources such as tuna appear to be plentiful in Tuvaluan waters and the Fisheries Division has given priority to the exploitation of those resources. This decision may also be brought about by the uncertain market outlook for clam products and the limited competitiveness of Tuvalu, essentially because of high transport costs compared to Fiji and because of lack of facilities for food processing. A lesson from this case is that because of the structure of the transport system in the Pacific, it may not be advisable to promote the development of the same 'export' industry in a 'central' country like Fiji and in a 'satellite' nation such as Tuvalu.

Keywords: Giant Clam culture, Tuvalu, Pacific Island nations,

JEL Classification: Q57, Q31

GIANT CLAM CULTURE IN TUVALU: PROSPECTS FOR DEVELOPMENT

1. Introduction

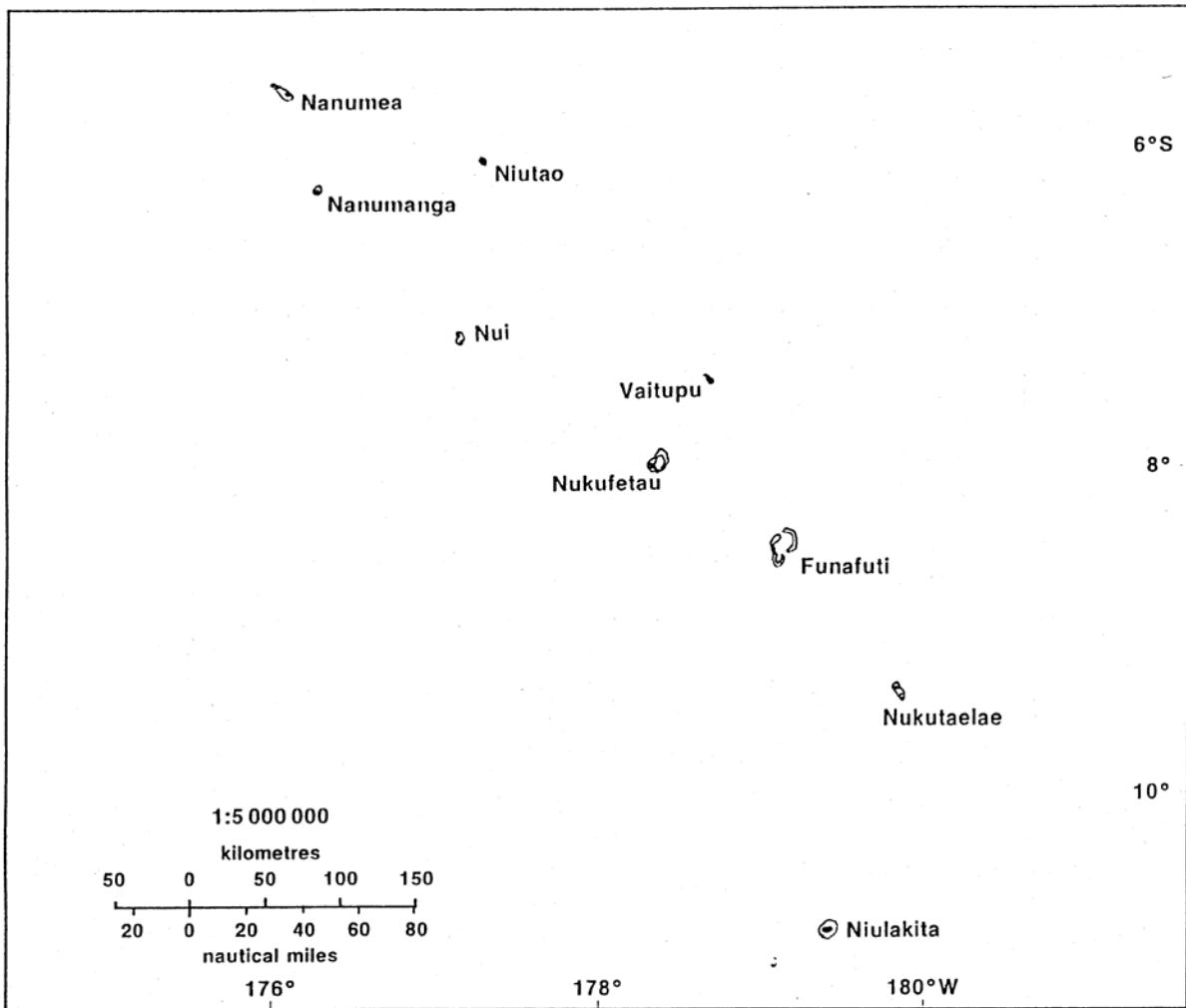
Tuvalu is a small island country in the Pacific with limited land resources and high population density. Marine resources appear to be plentiful but are largely unexploited. The Tuvalu government is interested in fostering aquaculture activities and for this reason Tuvalu was included in the multi-country research project on giant clams financed by ACIAR.

In this paper the prospects of giant clam mariculture in Tuvalu are considered and some lessons from this case study are drawn. A brief outline of the environmental and economic characteristics of the country is given. Then, the status of clam stocks and their exploitation is presented. The scope for giant clam culture development in Tuvalu is considered, against the background of the fisheries sector as a whole.

2. The Country

When it became independent on October 1, 1978, Tuvalu, previously known as the Ellis Islands, adopted its present name which means 'Eight Standing Together'. The archipelago is actually formed by nine atolls, but one, Nulakita, was not permanently inhabited at the time of independence.

The country is located between latitude 5° and 10° South and longitude 176° and 179° East (see Map 1).



Map of Tuvalu

The atolls spread over 560km on a line from North to South. The total land area is 25.0km² and the sea area is 900,000km². The climate consists of a rainy season (November to February) and a dry season with temperatures varying between 22° and 38°C. The rainfall varies considerably between the islands and from year to year, with an average of 3,000mm in the islands furthest to the South. Tuvalu is subject to cyclones and, given the low altitude of the land above sea level (maximum altitude 6m), there are fears of an eventual disastrous impact from the 'Greenhouse' effect.

The people of Tuvalu are mainly Polynesians with a minority of Micronesians. Total population was estimated to be around 9,000 people in 1990. Its population in relation to land area is amongst the highest in the world (350 persons/km²). The average annual population growth rate was 1.7% between 1982 and 1987 (SPC, 1989). This growth rate is not high by

developing country standards, but it obviously poses serious problems to a country poorly endowed with natural resources and with an already high population density. SPC (1989) estimates that the total population of Tuvalu in the year 2000 will be 10,900. This will result in a population density of over 400 persons/km².

3. The Economy

Tuvalu, together with the Cook Islands, Niue, Tokelau and Kiribati, has been defined as a MIRAB economy in order to stress its dependence on remittances from migration and aid and on wage employment in the bureaucratic sectors (Bertram and Watters, 1985). In Tuvalu, per capita foreign aid was A\$561 in 1985, an amount that almost matches the per capita GDP of A\$614 in the same year (SPC, 1989). Two-thirds of employed Tuvaluans work overseas (Connell, 1988) and remittances are estimated to represent about 30% of foreign revenues, of which 40% come from philatelic sales. In 1985 the trade balance showed a negative figure of A\$3,969,000 about 80% of GDP. This negative trade balance was compensated by foreign aid funds amounting to A\$4,601,000.

The above economic features have led Bertram (1986) to argue that the development problem faced by governments of Pacific microstates is not the promotion of capitalist goods-producing activities, but how rent income, that is, in particular aid, can be made more secure and predictable and how it should be allocated among members of the island community. This rent-seeking behaviour should be paralleled, according to Bertram, by the promotion of the informal sector, that is of the village-made production. The maintenance of traditional production systems would allow villagers to revert to subsistence life in case of a reduction in or a drying up of aid and remittance funds.

However, there are some problems with this approach. Economic dependence on foreign countries also implies political dependence and this might not be acceptable for independent states. With this motivation, Kiribati has renounced budgetary aid (Pollard, 1987) but it is fair to say that was possible partly because of the existence of income coming from the Revenue Equalisation Reserve Fund, established out of phosphate revenues. The establishment of a fund tends to reduce the degree of political dependence on other countries and uncertainty in financial flows. Tuvalu has been successful in having a Trust Fund established by the traditional aid donors. The fund, established in 1987, amounts to A\$27 million and is administered by Westpac through a board that has representatives from the

United Kingdom, New Zealand and Australia (Connell, 1988). The existence of the fund certainly reduces Tuvalu's political dependence in the short term, but it is not obvious if this also applies to the long term. A rising population implies a decreasing per capita annual income from the fund and changing needs of the people, requiring higher income, and might require a continued dependence on donors to increase the capital component of the fund (Cf. Tisdell, 1990, Ch. 10).

A more subtle effect of reliance on foreign aid is its sociological and psychological impact. There is some (dated) evidence that households have a relatively high degree of resilience to external conditions which allows them to shift between cash and subsistence activities (Lawrence, 1983). The long term impact of aid, however, may be to reduce this resilience, thus leading to increased dependence on aid. The negative social and cultural implications of this aid dependence are often underestimated in economic circles but they should be taken into account (e.g. Wendt, 1987).

Some questions that should be asked when deciding if and how to implement Bertram's strategy of informal- sector promotion are: What are the needs of the villagers? What are their aspirations? What actually is nowadays the 'village-mode of production' and what are its features? In the debate about the future of the Pacific Islands, it is often assumed that planners and academics have answers to these questions but, for example, Clarke and Morrison (1987) stated that not much is known on the livelihood strategies and decision-making processes of rural Fijians, and Fiji is certainly a country that has been the subject of more research studies than other Pacific countries.

It should also be made clear that individualistic capitalist modes of production are not the only one that can be adopted for production of goods. Community projects and cooperatives are often thought of as having a poor development record in the Pacific. This is however a generalisation that does not help the debate on development.

The performance of a community project depends on several factors such as cultural values, community cohesion, leadership and type of activity. There are certainly community development initiatives that have failed but there are also others that have been successful because they have paid attention to the above factors (Schoeffel, 1983). Tuvalu has a strong tradition of community work and many different groups are active in all aspects of community life (Chambers, 1984) and could be involved in new economic projects.

In the following sections the status and prospects of giant clam farming in Tuvalu will be analysed at a general level. It should be understood that if the Government, through the Fisheries Division, intends to pursue clam farming at the village level, **a detailed analysis of local conditions would be needed.**

4. Background On The Fisheries Sector¹

Local fish stock of Tuvalu is thought to be one of the highest in the Pacific. However exploitation of sea resources is constrained by limited infrastructure and by the isolation of the country and the logistics of accessing distant export markets.

The Fisheries Division, which is part of the Ministry of Commerce and Natural Resources, heavily relies on foreign assistance. Lack of equipment (e.g. the Division does not have its own means of transport) and of skilled personnel are major constraints on the operation of the Division.

The Division has identified major areas for special attention and included in these areas are resource assessment, commercial fisheries development and aquaculture.

Tuna is an important resource almost unexploited but costs incurred for export to foreign markets may hinder the development of tuna fishing. Bêche-de-mer is another unexploited resource for which the last recorded exports occurred in 1980. A survey of the stock is being planned by the Division as bêche-de-mer have seen an increase in their price and commercial exploitation will be attempted in the near future. Other resources being assessed are deepwater snapper and resources of the seamount.

Of particular relevance to this paper are developments in coastal subsistence and artisanal fisheries. A large proportion of outer island fishermen use traditional fishing methods and the Division is trying to integrate traditional methods with new techniques in order to increase the catch. This initiative is paralleled by the establishment of community fishing centres on several atolls. These centres have the specific task of concentrating on the production of dried and smoked fish in order to develop a small-scale export industry, targeting countries like Fiji, The Marshall Islands and New Zealand. If possible, fish drying will be carried out using

¹ This section draws upon Herr (1990)

solar and agri-waste energy.

In aquaculture, possible exploitable resources are milkfish, pearl oysters, seaweeds and giant clams. The outlook for giant clams will be discussed in detail later on. Trials of seaweed culture started in 1988 with stock imported from Kiribati but have not been very successful due to strong seasonal winds. It is interesting to note that very recently Kiribati has struck a deal with a Danish company that will buy all the seaweed Kiribati can produce. More than ten islands across Kiribati have been targeted for cultivating seaweed, this being part of a farming project (sponsored by New Zealand) that uses locally available resources such as sticks and coconut fibre, thus involving a minimal capital investment (Pacific Islands Monthly, 1991). This example obviously provides an incentive to Tuvalu to develop seaweed farming.

5. Giant Clams In Tuvalu

In order to assess giant clam stocks and the potential for clam mariculture in Tuvalu, two field assessments have been undertaken by natural scientists. Braley (1988) surveyed the atolls Nukufetau, Nukulaelae and Funafuti. Langi (1990) surveyed the northern atolls Nanumea and Nui.

The species reported to be present at the time of Braley's survey were *Tridacna maxima* and *T. squamosa*. Shells of *T. gigas* were also found but not one live animal was identified. Stock estimate densities for *T. maxima* were 'quite modest' at Nukufetau and Funafuti (63 and 101 clams per hectare respectively), and 'very low' at Nukulaelae (3.1 clams per ha.). *T. squamosa* was not found in the lagoon of Nukulaelae and stock estimate densities at Nukufetau and Funafuti were reported to be 'very low' (0.68 and 1.4 per ha.).

The attributes 'modest' and 'very low' were defined by comparison 'with other islands in the South Pacific and the Great Barrier Reef region' (Braley, 1988, p. 3). As Braley's was the first quantitative survey done in Tuvalu, numerical estimates of past clam densities are unavailable.

The analysis of size, frequency and distribution of *T. maxima* at sites varying in distance from the villages and the analysis of fresh dead shells provided evidence of harvesting pressure on natural stocks of this species.

Interviews with villagers were also undertaken by Braley in order to get their personal opinions about the past and present use and availability of clams, knowledge of basic ecology of reef animals, need for restrictions on clam harvesting and interest about possible involvement of the Government of Tuvalu in clam mariculture. Approximately thirty people were interviewed in each atoll, women and men in the same proportion and distributed relatively equally across three age groups, old, middle-aged and young. A summary of the results of the interviews is presented in Table 1 together with the results of the stock assessment. These results will be commented on briefly.

Clam meat consumption appears to be modest, especially in Funafuti. It should be noted that while the survey did not identify *T. squamosa* in Nukulaelae, interviewees in this atoll reported to have eaten such clam species. That could mean that *T. squamosa* is very rare in Nukulaelae so that it was not found by the survey team, but villagers occasionally find it and eat it or that it has recently become locally extinct. As *T. squamosa* was found in limited numbers in Nukufetau and Funafuti, lack of restrictions of collection could lead to this species' extinction in Tuvalu (if the other atolls not surveyed have equally low clam population densities).

In this respect, giant clam meat was not mentioned as a food item by Chambers (1984) who did an anthropological study in the northernmost atoll of Nanumea between 1973 and 1975. Chambers also reports that shellfish had a very marginal role in Nanumeans' diet and formed a small part of their diet. The atolls of Nanumea and Nui were surveyed by Langi (1990). The only species found was *T. maxima* and clam populations per hectare were much lower than those recorded by Braley (1988). For Nanumea, Langi reports 0.59 clams/ha. and for Nui 2.72 clams/ha. These low densities suggest that a certain degree of depletion may have occurred, even if it has not yet been determined how much of this depletion can be attributed to human activities. That a sizeable density reduction is occurring possibly because of human activities is confirmed by the fact that villagers interviewed suggested that the numbers of clams have decreased over time, resulting in an increase in the importance of fish over clams in their diet. Note also the apparent complete depletion of *T. squamosa* which the inhabitants of Nanumea reported to be found on the reefs of the atoll in the past.

TABLE 1 SUMMARY OF THE FINDINGS OF BRALEY (1988)

	Atoll		
	Nukufetau	Nukulaelae	Funafuti
Existing stock:			
<i>T. maxima</i>	quite modest	very low	quite modest
<i>T. squamosa</i>	very low	not found	very low
Consumption:			
quantity (clam/person)	1-2 weekly	1 monthly	irregular
species	<i>T. maxima</i> (mainly)	<i>T. maxima/squamosa</i>	<i>T. maxima/squamosa</i>
shell length (cms)	12-18	12-30	12-35
price	\$1-2/plate	n.r.	\$2/plate
Perceived scarcity:			
Male: Total	93% not scarcer	75% not scarcer	40% not scarcer 53% scarcer
By age: old	6.7% scarcer	scarcer	n.r.
middle	no change	scarcer	n.r.
young	no change	n.r.	n.r.
Female: Total	100% no change	66% not scarcer	33% not scarcer 60% scarcer
By age: old	33% scarcer	n.r.	n.r.
middle	no change	(some) scarcer	n.r.
young	no change	n.r.	n.r.
Ecology:			
Does collection affect clam numbers?			
Yes	93% men 44% women	60% men 40% women	n.r. n.r.
Effect: increase	majority	6.7% men	13% men 13% women
decrease	old men	'some' men & women	70% men 6.7% women
no relation	n.r.	n.r.	20% men
Should the Government try clam culture?			
Yes: men	100%	100%	100%
women	93.3%	100%	93.3%

Legend: n.r. = not reported

Source: Braley (1988)

Braley (1988) reports market prices for clam meat in Nukufetau and Funafuti, however the marketed meat must be a very small proportion of total consumption of clam meat. In Nukulaelae, none of the interviewees had ever bought or sold clams. In Nukufetau only some young and middle-aged men had sold clams and only some old men had bought clams. Women had not entered the market. In Funafuti, '93% of men and 88% of women have never sold or bought clams; 6.7% [1] of men have never bought, but sold clams for \$2/plate; 12.5% [2] of women have never sold but bought clams (\$1-5/clam; 30-50c/small clam)' (Braley, 1988, p.27). This limited market activity should be taken into account in considering the possible role of giant clams in the economy of Tuvalu and of the villages. In fact, given that young people do not perceive giant clams as becoming scarcer their limited exploitation of the resource is possibly due to lack of marketing opportunities or their low desire for clam meat.

As far as clam scarcity perception by respondents, in Nukufetau and Nukulaelae, a large proportion of females and males alike think that clams are not becoming scarcer. However, older people appear to perceive that a decline in clam stocks is occurring. In Funafuti, the majority of the people recognised that clams are scarcer than in the past. Braley (1988) traces this lack of recognition of stock decrease to a lack of knowledge of the ecology of giant clams. He asked the respondents whether they saw a link between clam collection and future availability of clams. In Nukufetau, the 'majority' of interviewees thought that clam collection would increase future clam numbers, an answer dictated by the local belief that some juveniles will be recruited in the area where the clam was collected if the shell and part of the byssal attachment were left on the reef. However, only one man in Nukulaelae, and two men and two women in Funafuti believed that the latter would actually occur. Therefore, Braley's suggestion that lack of knowledge of clam ecology affected the perception of clam scarcity seems not to be completely warranted.

It is interesting to note that Vuki et al. (1991) in a survey conducted in the Lau Group (Fiji), found the perception of clam stock status was homogenous across villages, and was not influenced by age factor as it is in the case of Braley's survey. It is possible that villagers do not find clams to be scarce or to be becoming scarce relative to their demand for them or their use of them as a fishing resource. Their answers may therefore not relate to the size of clam populations or their abundance. One variable that should be considered in analysing scarcity perception is personal 'interest' in clams, i.e. as a fishing resource and/or as a consumption

item.

Finally, Braley asked the interviewees if they would like to see the Tuvalu government experiment with giant clam farming. All the respondents but three answered yes. It is unfortunate that respondents were not asked if they themselves were interested in farming giant clams. The interest of individuals in farming giant clams depends on its costs to them and its benefits to them. They may see the Government experiment in farming as costless. Thus, their answers to this question would be a very approximate measure of their own real interest in clam farming. Having to invest their own resources would change their 'perceived' interest in clam mariculture. If the Government invests in giant clam farming, there is not any kind of economic risk for the villagers. They may either gain or not gain but they do not lose.

Based on the evidence just summarised and the favourable environmental conditions, Braley's report concludes that Tuvalu has a good ecological potential for culturing *T. squamosa* and eventually *T. gigas*, *T. maxima*, the most common species in Tuvalu, is not considered useful for mariculture because it is slow growing.

Economic considerations were not considered in that report and the next section will look at economic potential of clam mariculture in Tuvalu. However, before moving to the next section it is useful to briefly summarise recent experience regarding clam culture in Tuvalu.

ACIAR (1991) reports that in October 1988 one thousand *T. derasa* (a non-autochthonous species) were introduced to Tuvalu from MMDC in Palau. However, only 146 of this stock still survive (1990). Also, Tuvalu has deferred establishing a hatchery because of limited staff and commitment to other higher priority projects.

6. Prospects For Giant Clam Culture

From the facts presented in the previous two sections, it is not surprising that the Fisheries Division of Tuvalu has suspended for the time being the start-up of giant clam culture in Tuvalu.

Local sea resources are plentiful. Lack of resources and difficulties of access to distant markets at present inhibits fuller exploitation of sea resources. In an environment of limited technical resources, it is preferable at this time to concentrate the effort in improving local capacity to exploit sea resources (e.g. subsistence and artisanal fishing) which have a better

understood market, than concentrating on a totally new enterprise such as giant clam culture with a large degree of uncertainty about its profitability. Giant clam culture is however an option that could be taken up in the future by the Fisheries Division. Therefore, some factors that are likely to affect this mariculture activity are considered.

Hatchery techniques for giant clam culture have already been developed by the several research centres, that is, International Center for Living Aquatic Resources (ICLARM) Solomon Islands, Micronesian Mariculture Development Center Palau and Australian Centre for International Agricultural Research Australia, Fiji and Philippines. The need to establish a hatchery in Tuvalu is therefore strictly related to eventual commercial farming. Research in Tuvalu is mostly needed to adapt the ocean-growout phase to the local environmental conditions.

We have explicitly referred to commercial farming as it is not clear if clam farming could be adopted as a subsistence activity in Tuvalu. Some factors that may make clam culture unsuitable for the Lau group in Fiji have been discussed by Vuki et al. (1991). They are probably valid also in the case of Tuvalu. In Tuvalu people do not suffer from food shortages and giant clams are not so highly preferred to other food items to justify a relatively higher effort and investment compared to traditional fishing activities. Thus, like in the Lau group (Fiji), local people are likely to be interested in clam culture as a source of cash income.

The potential of commercial clam culture depends on several factors. Obviously, a much more important one is the market demand. The Tuvalu domestic market has not been surveyed but from Braley's (1988) limited data it can be considered to be fairly small. Tuvalu shows a sizeable external trade food deficit (see Table 2).

TABLE 2 TUVALU'S IMPORTS AND EXPORTS (1982) (,000 US\$)

	Imports	Exports
- Food and beverages,	692	27
of which: fish fresh, simply preserved	1	
fish tinned, prepared	57	
- Industrial supplies	664	
- Fuel and Lubricant	493	
- Machinery	240	
- Transport equipment	186	
- Consumer goods	406	10
- Others	259	
Total	2,940	37

Source: United Nations (1987)

Whether giant clam meat could replace a share of food imports is a matter for speculation as the farm-gate price for clam meat and therefore the market price, is yet unknown for a developing country. An approximation of that price will be possibly derived from the estimate of farm-gate prices for ICLARM's large and small-scale clam projects in the Solomon Islands. That would be the first available estimation of farm-gate prices for giant clams cultured in a developing country and should be available towards the end of October 1991 (John Hambrey, pers. comm.).

Overseas market prospects for clam meat, both fresh and preserved are still uncertain. Stanton (1990) could not draw any firm conclusion on the potential market for giant clam meat as the available international trade statistics for marine products, for which clam meat could be a substitute, were not sufficiently disaggregated. Shang et al. (1991) reports that markets for clam meat exist in Okinawa (Japan), Taiwan and Australia. The Okinawa market may absorb up to 300 metric tonnes of giant clams **in-shell** for sashimi and sushi dishes. The preferred species is *T. crocea* but eventually *T. squamosa* might also be consumed, but only if it had a price lower than that of *T. crocea*. Air freighting to meet the Japanese market from Tuvalu would be both expensive and risky, for example, clams may have to be transhipped en route and may therefore be damaged.

As the clams are preferred in-shell of a size varying between 5 and 6 centimetres, eventual farming targeted to this market is likely to be on-shore based, thus reducing to a minimum natural advantage of Pacific countries in clam farming, i.e. natural environmental conditions. Also, *T. crocea* the favoured species in Okinawa (Japan) is not naturally occurring in Tuvalu.

In Taiwan, markets exist for fresh or frozen clam adductor muscle and it has been estimated to have the potential for 240m metric tonnes per year (Shang et al., 1991, p.10). The species most suitable for this market in order of preference are *T. gigas*, *T. derasa*, *Hippopus*, *T. squamosa*, and *T. crocea*. At present clam products other than fresh or frozen adductor muscle are not available in Taiwan and a market for giant clam mantle meat does not currently exist there. Giant clam products are said to be unknown in Hong Kong, but based on interviews with seafood dealers, Shang et al. (1991) have the impression that it is worthwhile attempting the development of a market for clam products in Hong Kong. Other potential markets are those of New Zealand (Tisdell and Wittenberg, 1990) and possibly the West Coast of United States where many Pacific Island migrants live.

Can Tuvalu gain access to these markets? Transport costs are against it. Cargoes from Tuvalu to major destinations have to go via Fiji thus the developing clam industry in Fiji has certainly an advantage over that of Tuvalu. The market success of giant clam products appears to depend on its ability to compete with other processed seafood products, at least for what concerns major markets such as Japan and Taiwan. Currently Tuvalu does not possess the necessary know-how and facilities to process clam products. If the previously mentioned development of fish processing in Tuvalu takes place and can be applied to clams, that would relax the transport constraint to some extent.

7. Conclusion

The Government of Tuvalu appears determined to attempt a fuller use of the country's marine resources. Priority has been given to these resources for which traditional technologies are already available and/or to those whose markets are better understood.

The development of giant clam culture has been put on hold because of the poor outlook of market prospects for clams produced in Tuvalu and because of lack of technical and human resources on the part of the Fisheries Division.

It is uncertain what the size of the market for clam meat will be like. If an export market opens up, Fiji is favoured in entering that market in comparison to Tuvalu. This is because Fiji is more advanced in the food processing industry and has lower transport costs. The exports from Tuvalu have to go via Fiji and this clearly means higher transport costs. Because of the structure of the transport system in the Pacific, it is perhaps not desirable to attempt to induce the growth of the same industry (e.g. which has a clam production) in two countries one of decisive advantage in production and transport costs. Of course, this is a general principle.

A further lesson, not a new one, is that foreign aid can become a burden for the recipient country, especially when it has limited human and technical resources like Tuvalu. However, it can be difficult on the donor's side to actually provide what the recipient country really needs, as scarce technical and human resources also mean a limited capacity to identify needs and establish a program of action.

Finally, clam stocks in Tuvalu appear to be dwindling and continued exploitation could lead

to the disappearance of *T. maxima* and *T. squamosa* from the waters of Tuvalu as seems to have already happened to *T. gigas*. Government intervention to regulate clam collection is required to protect clam stocks because the local communities do not recognise this need.

8. Acknowledgements

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