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► **To cite this version:**

Clem Tisdell, Bernard Poirine. Economics of Pearl Farming. Paul Southgate, John Lucas. The pearl oyster, Elsevier Science, pp.473-496, 2008, The Pearl Oyster, ISBN-13: 9780444529763. <halshs-01141429>

HAL Id: halshs-01141429

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Submitted on 13 Apr 2015

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CHAPTER 13

Economics of Pearl Farming

Clem Tisdell and Bernard Poirine

s0010

13.1. INTRODUCTION

p0010

The pearl oyster industry has experienced substantial economic change particularly in the last 50 years or so. It has been transformed from an industry dependent solely on wild catch to one that depends mainly on the culture of oysters, either taken from the wild, then seeded and cultured (a form of ranching), or on oysters raised in hatcheries and then grown out (see Chapter 7). Moreover, the industry's structure has altered due partly to market developments and new technologies and the spread of knowledge about techniques for culturing pearls.

p0020

In this chapter, the market structure of the industry is discussed and related to new technologies, differences in the industry's socio-economic impacts are explored, sources of market supply are considered and features involved in the marketing of pearls are given particular attention. Most, but not exclusive attention, is given to the experiences of the Australian and French Polynesian pearl industries. Australia is the major global producer of the South Sea pearls and French Polynesia is the main global supplier of Tahitian black pearls (see Chapter 9).

p0030

According to Love and Langenkamp (2003), South Sea pearls obtained from *Pinctada maxima* and Tahitian black pearls, derived from *Pinctada margaritifera* together account for about a half of the world market by value. Japanese Akoya pearls and Chinese freshwater pearls, produced from mussels, each supply about a quarter of the world market by value. Twenty-five years ago, Japanese Akoya pearls supplied 90% of the value of the world market. However, Japan no longer dominates the global pearl

market. In this time, Australia, French Polynesia, Indonesia and China have secured substantial shares of the world sales of pearls.

According to IEOM (2005), Japan is still the major world importer of raw pearls, i.e., US \$241 million, with a 58.5% market share. It is also the top exporter of worked pearls (necklaces and other pearl made jewelry) with a 25.7% market share, followed by Australia (23.3%), China, Hong Kong and French Polynesia. In 2004, French Polynesia was the top producer of raw seawater pearls, with 26.9% of the total pearl market, followed by Indonesia (23.6%) and Australia (19.5%).

13.2. CHANGING TECHNOLOGIES AND THE INDUSTRY'S MARKET STRUCTURE

New technologies and more widespread access to technologies for cultivating pearls have played a major role in altering the economic structure of the cultured pearl industry. Japanese domination of the global pearl industry during most of the 20th century arose to a large extent as a result of its early development of methods for culturing pearls. Koichi Mikimoto played a key role in the development (see Section 8.10.1), was a very successful innovator and marketer and his firm is reputed at its height to have supplied about three-quarters of the world supply of pearls. Mikimoto Pearls still retains an important general market position but now there are several other important suppliers. It has been claimed that Japan dominated the cultured pearl industry for many years by keeping its implantation techniques secret.

The structure and nature of the pearl industry varies between countries but on a global scale, the pearl oyster industry is dominated by a few large vertically integrated companies. While some small producers have embarked on pearl production from oysters in developing countries, they are not vertically integrated and only contribute a small fraction of global output.

In order to appreciate, the interdependence between new technologies in pearl production and market structure, consider the Australian and French Polynesian industries for illustrative purposes.

13.3. THE AUSTRALIAN AND TAHITIAN PEARL INDUSTRIES: CHANGING TECHNOLOGIES AND MARKET STRUCTURE

Australia is the world's major supplier of South Sea Pearls. Most of its pearls originate from Western Australia's northern coastal areas (85%), with some contribution from the Northern Territory (14.6%). Queensland makes only a minor contribution to total production (0.2%).

The Australian pearl oyster industry developed as a captive industry in the second half of the 19th century. Mother-of-pearl shells used for buttons and inlay work became

its mainstay and Australia supplied up to three-quarters of world output. Australian production peaked by the beginning of the 1920s and then began to decline. Initially this was because open access existed and over-harvesting occurred. Subsequently, by the 1930s the advent of plastic buttons and the Great Depression reduced demand for mother-of-pearl shells. Production virtually ceased during World War II and while there was some recovery in production thereafter, the market eventually faded away. In 1987, permits were not longer issued in Western Australia for the collection of mother-of-pearl shells (Fletcher *et al.*, 2006).

p0100

The main reason for this cessation was not only the decline in the demand for mother-of-pearl shells but the switch of the Australian pearl industry to the culture of *P. maxima* for pearls. Until 1949, the culture of pearls was prohibited in Western Australia (Fletcher *et al.*, 2006). In 1956, Nicholas Paspaley Snr. formed a joint venture company, Pearls Proprietary Ltd., in conjunction with a Japanese businessman and began culturing South Sea pearls at Kuri Bay, 420 km north of Broome in Western Australia. This, the first commercial venture to culture pearls in Australia, was a success and in 1963, the Paspaley Pearling Company in conjunction with another Japanese company began culturing pearls at Port Essington, east of Darwin in the Northern Territory. By the early 1980s, the Kuri Bay farm was culturing 200,000 oysters per year and the Port Essington farm 70,000 oysters per year.

p0110

Paspaley Snr. was a “first mover” in the culture of pearls in Australia. He had many years of experience in the pearl oyster industry prior to this. He was also able to draw on Japanese experience in pearl culture. Eventually, the Paspaley Pearling Company would come to dominate the supply of Australian pearls and account for more than two-thirds of Australian supply. It would become a major force in the global South Sea pearl market. The second major Australian producer of South Sea pearls is M.G. Kailis. Together, these firms dominate the Australian industry.

p0120

Whereas the Paspaley Pearling Company has basically specialized in the pearl industry, M.G. Kailis Group entered the industry as a means of diversifying its business interests in its existing marine industries, mainly seafood production and marine services. It entered the industry in 1974 and is the world’s second largest global producer of South Sea pearls.

p0130

In Western Australia and the Northern Territory, the supply of South Sea pearls is indirectly controlled by government quotas on total allowable catch (TAC) of wild oysters for seeding. Around the mid-1980s these quotas became binding in Western Australia (Fletcher *et al.*, 2006, see Section 9.3.3). These quotas are important for ensuring sustainable catches and for helping to maintain South Sea pearl prices. At the same time, the introduction of quotas undoubtedly advantaged those already established in the industry. While quotas are transferable, there appears to be little trade in these. Greater detail of the quota system used to manage the Western Australian pearl industry and the zones employed by the industry are given in Section 9.3.3.

p0140

The second major development on the aquaculture side of relevance to the Australian pearl industry has been the development of hatchery-based production of *P. maxima*. Since 1992 in Western Australia, pearl producers have had an option of meeting some of their TAC by substituting hatchery-based oysters for wild oysters.

However, this substitution has basically been confined to the southernmost pearling zone (Zone 1) of Western Australia where wild recruitment and catches are erratic and where wild catch to effort ratios are much lower than in Zones 2/3 centered on Broome. (Fletcher *et al.*, 2006). In 2001, total wild oyster catch per hour in Zone 2/3 was 41.7 whereas in Zone 1 it was only 7.3, and in 2000 it was respectively 54.2 compared to 11.3 (Fletcher *et al.*, 2006).

p0150 The decision not to use hatchery-bred oysters in Zones 2/3 but to use them in Zone 1 seems to hinge on the comparative cost of the wild catch. In Zone 2/3, it is cheaper to rely on wild catch. While about half of cultured oysters are obtained from hatcheries in Zone 1, overall more than 90% of Western Australia's pearl supply comes from wild catch. Without the use of hatchery-bred oysters in Zone 1, it is doubtful if pearl oyster farming there would be sustainable.

p0160 Apart from technological advances in the culture of Australian pearl oysters, advances have also occurred in the harvesting of wild seed oysters and their husbandry. Technological change has resulted in the industry becoming more capital intensive in Australia. When such economies in marketing are also taken into account, significant economies of scale seem to be experienced by their industry. Apart from barriers to entry created by the quota system, scale economics may be a significant barrier to entry into the Australian South Sea pearl industry.

p0170 In French Polynesia, pearl culture was initiated in 1963 when the head of the Fisheries Department, Jean Domard, decided to try to graft the local oyster *Pinctada margaritifera*, with the help of an Australian company and two Japanese grafters. He obtained what are now called black pearls or Tahitian pearls. But it took many years before private pearl farms began to produce significant quantities, thanks to a few pioneers such as Jean Claude Brouillet and David Rosenthal (see Section 9.4.3.1). At first the product (the black pearl) was unknown to jewelers, and it took a lot of effort to make it known and appreciated by jewelers and consumers worldwide.

p0180 Production really started to grow in the 1980s, and then accelerated in the 1990s, then came to a sudden halt in 2000–2001, as prices plummeted and world imports were affected by a series of adverse events including the Kobe earthquake, the September 11, 2001 attack, SARS in Asia and the war in Iraq). From 29 kg in 1980, pearl production reached 575 kg in 1990 (a 20-fold increase), and 11,541 kg in 2000 (another 20-fold increase), reached a peak of 11,161 kg in 2001, and then has shown a regular decline since then, i.e., 7,304 kg in 2005 (see Section 9.4.3). The general pattern is evident from Figure 13.1.

p0190 The steep decline in the price per gram of black pearls is the result of a supply curve sliding much faster to the right than the demand curve in the 1990s. As a consequence a 20-fold increase in the quantity supplied was met by an equivalent increase in the quantity demanded thanks only to the average price falling to one-fifth of its earlier level. While the world market share of the Tahitian pearl expanded rapidly from a negligible amount in the 1980s to around 25% in 2000, it has stagnated since. In the mid-1980s, the Tahitian pearl was seen as a rare, niche market upscale product, and benefited from the decline in the Japanese Akoya pearl supply. In the 1990s, its falling price led to it becoming a more widely marketed product. Moreover, while for a long time Tahiti had

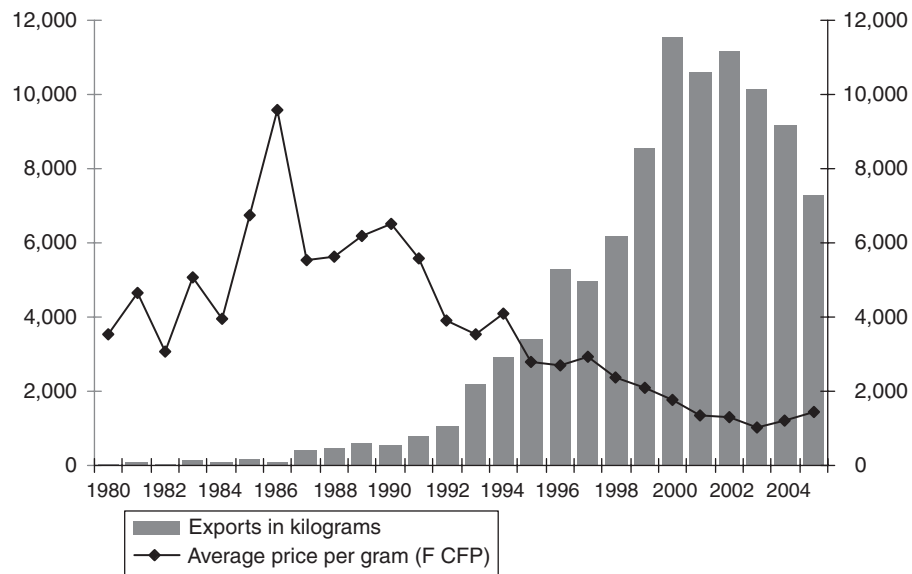


FIGURE 13.1 Pearl exports and price per gram of pearl exports from French Polynesia, 1980–2005.
Source: ISPF.

a monopoly on the black pearl (obtained from *Pinctada margaritifera*), competitors began to emerge at the end of the 1990s, in the Cook Islands, Indonesia and elsewhere.

There are no oyster quotas in French Polynesia, and no hatchery, because spat can be collected in many lagoons, to provide the juvenile oysters producers need for grafting, without danger of depleting the wild stock (see Section 9.4). As a result, no limit has been set to the number of producers. However, since 2002, the local government requires producers to hold a professional card and the proof of a maritime concession of at least 1 ha. The professional card is given to persons proving their aptitude and ownership of equipment for pearl production. As a result of the falling prices, the number of producers has been declining since 2001, as well as production. As of November 2006, there were 409 oyster producers and 421 pearl producers (many engage in both activities). There were a total of 516 pearl farms in 31 islands, most of the islands (27) being in the Tuamotu and Gambier archipelagos.

The distribution of ownership of pearl farms by size in French Polynesia is shown in Table 13.1. Forty-one large farms (each with more than 40 ha of maritime concession) make up more than two-thirds of the total surface area of maritime concessions (and therefore, probably also account for about two-thirds of total production). A total of 505 small farms (less than 5 ha in size) make up only 5% of the total exploited surface area and 183 medium-sized farms (between 5 and 40 ha in size), account for 34.5% of the total area farmed with pearl oysters. Considerable inequality in the size of farms is evident.

TABLE 13.1
Structure of French Polynesia's pearl industry.

	Large	Medium	Small	Totals
Size of farms (ha)	>40	5–40	<5	
Total area of farms (ha)	6,601	2,609	505	9,715
Percentage of farmed area	67.9	26.9	5.2	100
Number of farms	41	183	307	531
Percentage of farms	7.7	34.5	57.8	100

Source: Service de la Perliculture, French Polynesia.

s0040

13.4. SOCIO-ECONOMIC IMPACT

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Pearl culture has the potential to provide increased economic opportunities to remote marine communities. For such communities, pearls have the advantage that their value is high in relation to their weight and they are easily storable. These two factors reduce transport difficulties. Several development organizations such as Worldfish Centre and the Australian Centre for Agricultural Research (ACIAR) have supported pearl projects in developing countries as a means to improve the livelihood of disadvantaged communities (e.g., Lane *et al.*, 2003; Southgate, 2004).

p0230

In Australia, the pearl industry is located in some of its more remote and sparsely settled areas. However, no farms are owned by Australian Aborigines who account for the major proportion of the population in these remote areas. Nevertheless, according to the Northern Territory Government: “various (Aboriginal) communities have significant involvement with the pearling industry. All the land for pearl farms around the coast is leased from traditional owners or land councils and the farms provide employment opportunities for indigenous workers”.

p0240

Such communities usually have few economic opportunities. Nevertheless, in the Northern Territory the industry only directly employed about 300 persons in 2004. In Western Australia, it has been estimated that the industry employs directly about 1,500 people, most of whom are from Broome (Fletcher *et al.*, 2006). Taking into account indirect local employment and assuming a regional multiplier of around 1.5, the pearling industry may result in the employment of 2,500–3,000 persons in northern Australia.

p0250

It is interesting to note that even today Mikimoto Pearls claims as one of the achievements of Koichi Mikimoto, his contribution to economic development of remote island areas. Mikimoto America states:

“While trying to meet the challenge of producing black lipped and silver lipped cultured pearls, he [Koichi Mikimoto] encouraged the development of local pearl industries on previously underdeveloped islands. He contributed so significantly to the development of these islands that the name “Mikimoto” is spoken of with reverence even to this day.”

p0260

However, we cannot assume that the development of pearl culture is always beneficial to local communities.

p0270

In recent years, several Pacific Island communities have been given aid to develop the culture of pearl oysters, particularly *P. margaritifera*, as a means of assisting their economic development. Southgate *et al.* (2006) states:

“As demonstrated in the Pacific, cultured pearl production can provide considerable opportunity for income generation for coastal communities. Pearl production may occur on small family-based pearl farms and individuals may enter the industry at a number of levels to produce oyster shells (mother-of-pearl), half-pearls or round pearls, or they may simply collect spat from the wild for sale to pearl farms. Furthermore, the pearl industry provides opportunity for the involvement of women and provides the raw materials for local handicraft manufacture which may include lower grade pearls or pearl shell.”

p0280

In French Polynesia, pearl culture was successfully developed by private initiative, once Jean Domard, Head of the Fisheries Department, had proven that it was possible to obtain cultured pearls from *Pinctada margaritifera* oysters in the 1960s. But it took a lot of courage for a few entrepreneurs to pioneer this all new product in the mid-1970s and make it known worldwide. Pearl culture took place in the remote Tuamotu and Gambier archipelagos that had been greatly depopulated during the 1960s because of French atomic testing in Mururoa: the center for atomic experiments needed labor to set up in military bases on Hao, Fangataufa and Mururoa, so most young people went from fishing and copra culture to well paid employment by the military. Once the military installations were completed, many were engaged as servicemen or went to work on the main island of Tahiti in the military bases there. Therefore, when the pearl industry picked up in the 1980s and 1990s, it led to a repopulation of both archipelagos: many people came back from Tahiti to their island of origin, those who had saved and still had land tried to set up pearl farms, those who could not went to work for large-scale farms. As a consequence, the population of atolls such as Takarua, Fakarava, Manihi, shot up again, and the standard of living of their inhabitants was greatly increased, because prices in the 1980s were still high and pearl culture was very profitable, even for small-scale family farms, much more so than previous activities, such as copra culture.

p0290

In recent years, falling prices have made this activity less profitable than previously, and production has declined, as well as the number of pearl farms, but small-scale family farms have not disappeared, since they do not have to pay wages, and their grafters (pearl seeding technicians) are paid piece rates (most of the grafters are from China now). Many families spread risks by engaging simultaneously in other activities, such as: fishing, making and selling pearl jewelry for tourists, gathering copra, making handicrafts, operating small hotels, setting up lagoon and pearl farm tours for cruise boat tourists (especially on the islands of Tahaa and Raiatea).

p0300

Medium-scale farms with paid employees were the most affected by the pearl price downturn: small family farms could survive because they had no payroll, large-scale farms also survived because they had lower unit cost than medium-scale ones. An unpublished study by Poirine and Kugelmann for the *Service de la perliculture* found evidence of significant economies of scale in French Polynesia's pearl farming.

p0310

French Polynesia showed that small-scale pearl farming was possible outside Japan. Manihiki in the Cook Islands is another example of successful small-scale pearl farming using the *Pinctada margaritifera* pearl oyster.

p0320 Yet, as is to be expected, not all such projects in the Pacific islands have been an economic success. In this regard, a study of the reasons for economic failures as well as success could improve future decisions about proposed projects for pearl oyster culture in developing countries.

p0330 Demonstrating the technical feasibility of culturing pearl oysters in a developing country is only an initial step towards establishing whether this culture will be an economic success. Amongst other things, the techniques for the culture need to be successfully transferred to locals, (e.g., the government of French Polynesia is actively promoting the training of Polynesian grafters by creating a public school of grafting, in order reduce its dependence on Japanese and Chinese grafters), the resources needed for the culture must be available or affordable to locals and they must have adequate access to markets for their produce (early on, the government of French Polynesia encouraged small producers to market their products through cooperatives called “groupements d’intérêt économique” or GIEs. Several GIEs hold auctions in Tahiti once a year to sell the pearls of their members).

p0340 In Manihiki, Cook Islands, initial expertise came from a part Chinese, part Tahitian, part Cook Islander entrepreneur, Yves Tchen Pan, who set up a large-scale farm in Manihiki. To maximize the benefits for the local families, the Island Council of Manihiki entered into an agreement with Cook Islands Pearls, Yves Tchen Pan’s company: “Under the terms of this agreement, Manihikians dived for oysters, which were taken to Cook Islands Pearl’s farm. The farmers, who tended their own oysters with advice from Cook Islands Pearls, gained knowledge of farm husbandry practices, access to management advice, access to technicians, and a market for their pearls. In effect oysters were managed, seeded, harvested and marketed on their behalf by Tchen Pan’s company, Cook Islands Pearl Ltd., in return for 40% of the proceeds. With proceeds from sales of oysters, proceeds of their own crops’ sales, and the above arrangement, Manihikians could become established on their own farms relatively easily” (Macpherson, 2000).

p0350 In addition, Tchen Pan’s company helped family farms by renting out his grafting technicians, charging a small fee per oyster grafted. Experience in French Polynesia and the Cook Islands suggests that it is often in this way that locals acquire expertise: first by collecting and growing spat to juvenile size (which does not require much capital investment and is a relatively simple task). The proceeds from selling juvenile oysters can be reinvested over time by setting up oyster lines and getting the grafting task done by outside technicians hired by big farms or cooperatives (Lane *et al.*, 2003).

p0360 Furthermore, acceptable and enforceable property rights in the cultured pearl oysters must exist; otherwise, there will be a lack of economic incentive for their culture. In many developing areas, lack of “adequate” property rights in cultured species is a barrier to their commercial culture. The enforcement of property rights is a problem in many countries (Indonesia for example), and even in French Polynesia the frequent stealing of pearl oysters on the oyster lines is a problem for pearl farmers.

p0370 Another way to maximize the socio-economic benefits of pearl culture is to try to develop downstream activities adding value to the pearl, such as the sale of pearl necklaces (instead of raw pearls) and of pearl jewelry. This industry is worth more than the raw pearl trade worldwide. French Polynesia recently encouraged pearl jewelry for export by creating “free firms” (entreprises franchises in French): jewelers working the

Tahitian pearl may import inputs such as gold or silver or gold or silver made jewels free of tax, and export also free of tax (there is an export tax on pearls in French Polynesia). It is worth noting that Australia exported US \$77 millions worth of pearls in 2003 (18% of the world market), but was the first exporter of worked pearls (necklaces made of pearls), a US \$153 millions value, i.e., twice as much as the value of raw pearls exported the same year. It was for a long time Japan's privilege to import raw pearls from all over the world and to transform the raw material in necklaces through the lengthy process of pairing pearls of the same shape, quality, color and size that were re-exported to the rest of the world. This value added industry is now growing strongly outside Japan, in Australia, Hong Kong, and French Polynesia. The big producers, such as Paspaley in Australia or Robert Wan in French Polynesia, make their own necklaces and jewelry to reap the value added from marketing the finished product instead of the raw material.

p0380

Southgate *et al.* (2006) gave consideration to the possibility that the introduction of pearl culture to East Africa could assist the sustainable economic development of coastal communities. On the basis of early evidence from trials of the culture of *P. margaritifera* in Mafia Island Marine Park in Tanzania, they find physical production from such culture to be very satisfactory, and claim that the transfer of techniques for half-pearl production to locals is not difficult. They see the main market for the produce as being for jewelry to be sold at resorts on Mafia Island and through retail outlets in Dar-es-Salaam and Zanzibar.

p0390

Despite some economic uncertainties, the project is to be expanded. Southgate *et al.* (2006) state the following:

“The long term sustainability of this project will depend on reliable sources of culture stock. Expansion of current spat collection activities and development of local hatchery production are immediate goals for the project. Ongoing research will also investigate the potential for round pearl production within the [Mafia Island Marine Park] and development of local jewellery making skills.”

p0400

In the article, Southgate *et al.* do not mention whether property-rights issues are likely to be a problem, nor what the impact on the local community would be if the project is in the end not economically viable.

p0410

In relation to small-scale pearl oyster farming in the Central Pacific, Fong *et al.* (2005) came to the view on the basis of evidence from the Republic of Marshall Islands and the Federation States of Micronesia that it is likely to be profitable. Over a 2 year period of operations, they suggest that an internal rate of return of 9.6% is realistically achievable. However, this rate of return is quite sensitive to market price and mortality rates (Fong *et al.*, 2005). Furthermore, the representative pearl oyster farm that they model has quite large negative cash flows during the first 5 years of its operation (see Fong *et al.*, 2005) and financing these could be a problem for many local communities. There may also be differences of opinion about whether the size of the farm they envisage is really very small. They assume that a stock of 25,000 oysters for seeding will be maintained once the farm reaches a steady state.

p0420

Economic modeling software was developed by the Secretariat of the Pacific Community (SPC) in association with the Queensland Department of Primary Industries and Fisheries (QDPIF), Australia, to help assess various scenarios for development of

cultured pearl industries in Pacific island countries (Johnston and Ponia, 2003). Following inputs relating to farming costs (equipment, labor, maintenance, etc.), estimated production levels (yield) and product value, the software generates values for output parameters including annual gross revenue, annual production costs, production cost per pearl, revenue per pearl, and for economic parameters including net present value, annual return, internal rate of return and benefit–cost ratio. The models generated allow assessment of the economic viability of pearl farms of various sizes producing various products (e.g., pearl shell, half-pearl, round pearl). Using this software, economic models for various black pearl farming scenarios were generated for Kiribati in the central Pacific: (1) a large sized, private sector owned farm with 100,000 oysters producing round pearls; (2) a medium sized, private sector owned farm with 30,000 oysters; (3) A small sized, private sector owned farm with 5,000 oysters; and (4) a medium sized, private sector owned farm with 30,000 oysters growing mabé (half round) pearls (Table 13.2). The models generated also allowed estimation of the major contributors to pearl production costs for each farming scenario as well as discounted cumulative cash flow (Fig. 13.2).

Under the assumptions made in the model, a large sized, privately owned farm with 100,000 oysters producing round pearls was considered the best option (Table 13.2). The costs of establishing a large farm (Senario 1) in Kiribati was estimated to be around \$300,000 and annual operating costs would average \$300,000 (Southgate, unpublished data). Such a farm was estimated to require 6 years to break even but provided a reasonable risk profile, with a 67% chance of making a zero profit or less (Fig. 13.3). It would also be possible for four types of small business ventures to “spin-off” from such

TABLE 13.2
Output summary and economic indicators generated for various black pearl farming scenarios in Kiribati, central Pacific, using modeling software (see Johnston and Ponia, 2003). Senario 1: a large sized, private sector owned farm with 100,000 oysters producing round pearls; Senario 2: a medium sized, private sector owned farm with 30,000 oysters; Senario 3: a small sized, private sector owned farm with 5,000 oysters; and Senario 4: a medium sized, private sector owned farm with 30,000 oysters growing mabé pearls.

	Pearl farm options			
	Senario 1	Senario 2	Senario 3	Senario 4
<i>Output summary</i>				
Annual production (pearl)	9,673	2,902	484	5,892
Annual gross revenue	\$496,879	\$138,182	\$23,030	\$62,984
Annual production costs	\$306,483	\$113,852	\$33,804	\$50,747
Production costs per pearl	\$31.69	\$39.24	\$69.90	\$8.61
Revenue per pearl	\$51.37	\$47.62	\$47.62	\$10.69
<i>Economic indicators</i>				
Net present value	\$1,869,337	\$238,877	–\$105,779	\$120,145
Annual return	\$190,396	\$24,330	–\$10,774	\$12,237
Internal rate of return	28.33%	15.45%	NA	14.91%
Benefit–cost ratio	1.62	1.21	0.68	1.24

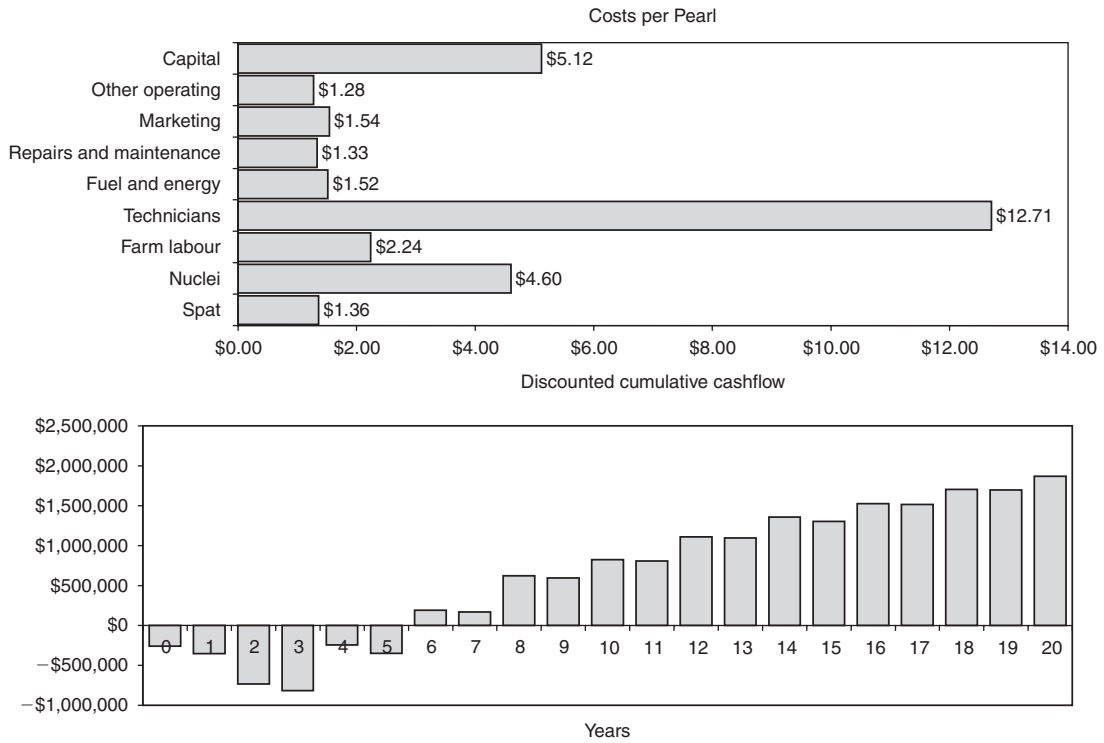


FIGURE 13.2 Relative contributions of the various components of pearl cost calculated using economic modeling software (Johnston and Ponia, 2003) for a large sized, private sector owned farm with 100,000 oysters producing round black pearls in Kiribati, central Pacific.

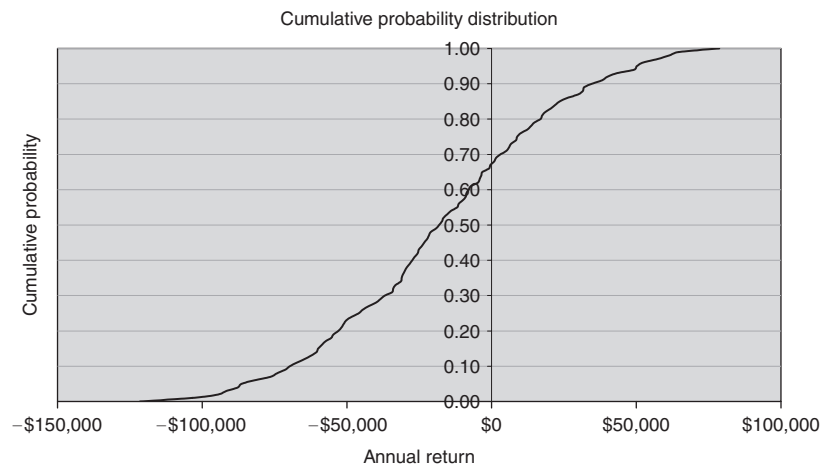


FIGURE 13.3 Predicted returns using economic modeling software (Johnston and Ponia, 2003) for a large sized, private sector owned farm with 100,000 oysters producing round black pearls in Kiribati, central Pacific. Summary of Risk Assessment indicates a 67% chance of zero profit or less with a lowest potential return of -\$121,519 and a highest potential return of \$78,677.

f0020

f0030



FIGURE 13.4 Handicrafts made from lower grade pearls and pearl shell offer opportunities for income generation in coastal and island communities in the Pacific islands. The photograph shows participants in a pearl handicraft training workshop held in Kiribati, central Pacific. (Photo: Antoine Teitelbaum.)

a farm: cleaning and gear making/repair services; culture of spat/juveniles to pearl producing size (to approximately 2 years old) and selling them to the central farm for pearl production; production of half-pearls (mabé) from oysters that have rejected nuclei; and use of pearl shell and lower grade round and half-pearls in handicrafts (Fig. 13.4).

13.5. PRODUCTION AND TRADE STATISTICS

It is very difficult to obtain accurate global statistics for pearl production and sales. However, some interesting statistics have been provided to *Pearl World: The International Pearling Journal* by the Golay Company, a leading trader in pearls (Anon, 2006a). Table 13.3 provides Golay's estimates of the value of world production of pearls in 2004 by types of pearls and the main countries producing these pearls. Estimates are at the pearl farm level. It can be seen that the value of South Sea cultured pearls (Australia accounts for the lion's share of supply) is highest followed by fresh-water cultured pearls from China, then Akoya cultured pearls and Tahitian cultured pearls, mainly from French Polynesia.

According to 2004 statistics from the Centre Français du Commerce Extérieur, cited in ISPF (2006), worldwide sales of unworked cultured pearls were at US \$412 million, French Polynesia being the top exporter with a 27% market share, Indonesia taking second place with a 24% share, and Australia taking third place. Japan and Hong Kong imported 79% of the total value of pearl imports in 2004. Total sales of worked pearls (pearls necklaces and earrings) amount to US \$787 million in 2004 (a 33% increase compared to 2003). Japan and Australia are the main exporters of worked pearls with a market share of 26% and 23%, respectively. French Polynesia's market share is only 7%.

TABLE 13.3
Value at the pearl farm level of world production of cultured pearls in US\$ in 2004
according to Golay's estimates.

Type of pearl and main producers	Value (US\$ millions)	Percentage of supply
White South Sea pearls (Australia, Indonesia, The Philippines, Myanmar)	220	35
Freshwater pearls (China)	150	24
Akoya pearls (Japan, China)	135	22
Tahitian pearls (French Polynesia)	120	19
Total	625	100

Source: Based on Anon (2006a).

TABLE 13.4
Global share of each country or region of the world pearl jewelry market in 2004
according to Golay's estimates.

Country/region	Value of sales (US\$ millions)	Percentage of total sales
USA	1,500	30
Japan	1,200	24
Europe	900	18
China	600	12
Southeast Asia	500	10
Other Countries	300	6
Total	5,000	100

Source: Based on Anon (2006a).

China's entry into the global pearl market had been important in recent years. It has become a major supplier of freshwater pearls. While South Sea Pearls have increased their market shares and so have Tahitian cultured black pearls, there has been a significant reduction in the market share of Akoya pearls (see Section 10.2).

The major markets for pearl jewelry, as estimated by Golay, are presented in Table 13.4. The USA is the major market followed by Japan, Europe, China and Southeast Asia. Pearls are particularly popular in Asia. Table 13.4 implies that Asia purchased more than half (over 52%) of the global supplies of pearl jewelry in 2004.

The United Nations Commodity Trade Statistics for 2005 provides data on the exports of pearls natural or cultured. The values of exports of the main exporting countries are shown in Table 13.5. These data indicate that Japan is the largest exporter, followed by Australia, China and French Polynesia. The value of exports by the Philippines and Indonesia are considerably smaller than the exports of the countries

TABLE 13.5

The value of exports of unworked pearls by the main exporting countries in 2005. The data are for category H52002-7101 in the COMTRADE statistics. United Nations, Statistics Division (2006) Commodity Trade Statistics Database (COMTRADE).

Country	Value of exports (US\$ millions)	Percentage
Japan	263.6	33.2
Australia	219.5	27.6
China	146.5	18.4
French Polynesia	128.3	16.1
The Philippines	15.45	1.9
Indonesia	10.7	1.3
Total	784.05	100

just mentioned and the data for Myanmar were not available. In some cases, the statistics would include re-exports and some exports from some countries, e.g., the Philippines and Indonesia, may bypass official channels and not be recorded. However, the data may give an indication of the relative importance of nations in international trade in unworked pearls.

The value of Australian pearl exports since 2002 have shown an upward trend whereas those of Japan have been relatively stagnant. However, Australian production of pearls by volume remains fairly stationary due to the quota system limiting the number of pearl oysters seeded for pearl production. This system has the twin objectives of ensuring that the take of wild pearl oysters is ecologically sustainable and of restricting supply so as to maintain prices for South Sea pearls. Because Australia is the globally dominant supplier of these pearls, it is in a position to influence their price internationally. Its strategy has been to limit supply and concentrate on improving the quality of the product and its promotion. A review early in this decade by the Australian National Productivity Commission, as a part of ongoing reviews of business competition in Australia, supported the continuation of this policy. This policy seems to be in Australia's interest since most of Australia's pearl production is exported and pearls, as a product, have features that require their marketing to be evaluated in a different way to most economic goods.

13.6. MARKETING AND THE NATURE OF THE MARKET FOR PEARLS

13.6.1. The economic nature of pearls differs from the majority of commodities

Even though pearls do not satisfy any basic needs, they are highly valued. Their value derives from their inherent beauty and the social "messages" they convey when worn

or given. Their relative scarcity, especially of sought after specimens, adds to their economic value.

p0510

Because social factors have such an important influence on economic value of pearls, they can be classified as Veblen-type goods (Leibenstein, 1950; Tisdell, 1972). Veblen (1934) stressed the importance of social factors in determining the economic value of some types of goods. Demand for pearls may be enhanced by emphasizing their exclusiveness, associating pearl jewelry with desired life-styles and images, and promoting their quality. In some cases, demand for pearls may even rise up to a point with an increase in their price.

s0080

13.6.2. Consequences of the characteristics of pearls for their marketing and market structure

p0520

Given the above attributes of pearls, considerable scope exists for major pearl suppliers to increase the demand for pearls by advertising and promotion and by securing the recognition of their brands. The earliest producer of cultured pearls, Mikimoto Pearls, recognized the importance of these aspects in its early development. It continues to promote its products heavily. A similar pattern has been followed by market leaders entering the industry later such as Paspaley Pearls, the leader in South Sea pearls, and Wan's Tahiti Perles, the major supplier of Tahitian pearls. In French Polynesia, in 1993, the government decided to set up a promotion board, the GIE Perles de Tahiti, financed by a tax on pearl exports. The tax is now set at 200 F CFP (French Pacific franc) per gram of exported pearl, but 35% of the receipts only go to the GIE Perles de Tahiti (50% before 2002). Promotion efforts at first went toward organizing trade events linked to jewelry and haute couture, and placing pearl necklaces in movies or television series in order to promote a luxury image for the Tahitian pearls. The United States, Japan and Europe were the main markets aimed at. From 1998 on, promotion is more geared toward the general public, and trying to create new markets (i.e., jewelry for young men and sales in the Middle East and Russia).

p0530

Major suppliers have an incentive to promote recognition of their brands. This is partly because many end-buyers are ignorant of the quality and market value of pearls and therefore, when purchasing more expensive pearls or pearl jewelry are likely to put their trust in well known brands. Branding and rigorous quality control help to build the reputation of major establishments in the industry. Brands also provide a focused means for promoting and advertising the social value of pearls. Furthermore, such a strategy may help the market to operate more efficiently by ensuring that the sale of poor pearls by less reputable sellers does not drive out producers of better quality pearls. This type of phenomenon is well recognized in the economics literature (Akerloff, 1970; Varian, 1987).

p0540

The downside of this phenomenon is that unbranded or little known suppliers of pearls are likely to be treated with suspicion by customers. Even when their product is of high quality, this is likely to be discounted by uncertain buyers. Consequently, small and relatively unknown suppliers of pearls and pearl products may obtain lower prices for the same quality product as that of market leaders.

p0550

To reassure buyers, the government of French Polynesia is considering the creation of a quality label for exported pearls. Quality controls already exist in French Polynesia for all exported pearls (see Section 9.4.6.2): before they can be exported, all pearl lots must go through an X-ray machine at the Service de la perliculture (Fig. 9.18). All pearls must have a minimum thickness of 0.8 mm of nacre around the nucleus. Pearls that do not qualify are rejected and crushed by the Service de la perliculture (Fig. 10.1). The producers are paid a small indemnity for the rejects, i.e., 50 F CFP per gram, with a limit of 500 g per year and per hectare of oyster grafted (arrêté N 1027 CM du 17 novembre 2005). The pearl lots qualifying for export are then put in a sealed bag and go directly to customs in their sealed bag.

p0560

It should also be noted that the quality and attributes of pearls are quite diverse. This may lead to market segmentation. Some types of pearls may be marketed to the high end of the market (e.g., high quality Akoya, Tahitian or South Sea pearls) whereas others may be sold to a lower market, e.g., Chinese freshwater pearls. Different marketing strategies may be used in different market niches or segments.

p0570

This raises the question of the extent to which pearls from different species or of different shapes and so on are substitutes. Where large suppliers of pearls specialize in supply from a particular species, they may in their promotion stress their special qualities compared to pearls from other species. This is intended to reduce substitution between pearls from different species. Furthermore, that there is probably a low degree of substitution between lower quality pearls and those of higher quality. This would be consistent with significant segmentation of the market. Furthermore, this segmentation is likely to be promoted by the marketing of leaders in the industry.

p0580

Thus, marketing considerations tend to favor large vertically integrated suppliers in the pearl industry. Therefore, for this and other reasons, the global industry appears to be characterized by a few large easily recognizable suppliers and by many small relatively unknown suppliers. The industry structure is dualistic or bipolar.

s0090

13.6.3. Further observations on the bipolar nature of the industry, constraints on new entrants, external costs in production due to the abuse of a common resource, and the existence of scale economies

p0590

The dominant suppliers in the industry appear to be those who made an early start in developing the culture of particular species of pearl oyster and which have on the whole specialized in these species. This applies to Mikimoto in Akoya pearls, Paspaley in South Sea pearls and Tahiti Perles in Tahitian black pearls. The dominance of these companies is reinforced by economies of scale in marketing, their considerable attention to quality control, their vertical integration and existing exclusive rights to utilize natural areas very suitable for pearl oyster collection and culture.

p0600

Efficient suppliers seem to benefit from an early entry advantage. It is extremely difficult for other firms entering later to emulate their success. Early entrants usually control the most suitable sites for pearl oyster culture, have benefited from learning by doing, are technologically sophisticated in their operations and have established market recognition and networks. For example, in French Polynesia, Robert Wan owns private

atolls, such as Nengo Nengo and Marutea, where no one else may produce pearls. He may then maximize quality by limiting the extent of pearl culture in the lagoon to prevent over-exploitation. This is not true of many pearl producers in a public lagoon: there is a risk of over-exploitation if too many producers extend their maritime concession and the government does not limit or does not enforce effectively the limits of each exploitation. In other words, only the producer owning a private lagoon can “internalize” the external cost of over-exploitation in a given lagoon. The recent (2001) episode of high oyster mortality in the lagoon of Manihiki in the Cook Islands (see Section 9.4.4) illustrates the external costs arising from over-exploiting the lagoon. Economic analysis of such external effects is given in Poirine (2003) and in a general context in Tisdell (2003).

p0610

It is interesting to note that 1 year before the high mortality peak in Manihi, a survey of the lagoon had determined that 30% of the lagoon surface was occupied by pearl farms. The study concluded that the number of oysters could be increased from 1.5 million at the time of the census to 2 millions: “Assuming space is properly managed in the lagoon then the portion of farmable strata occupied (30%) suggests that farming of two million pearl shells could be attained without density-dependent consequences on the health of the oyster” (Ponia *et al.*, 2000). Since then, however, the Government of the Cook Islands has enforced strict rules to prevent over-exploitation of the lagoons.

p0620

Similar high mortality episodes occurred in French Polynesia, at Takapoto atoll in 1985, at Hikueru atoll in 1994, at Manihi atoll in 1997. It is not yet sure if a virus is responsible, or if over-exploitation might weaken the natural defenses of oysters against all viruses already present in the lagoon. To prevent the reoccurrence of such events in French Polynesia, the government monitors the surface of maritime concessions allowed and exploited and tries to respect a policy of not allowing more than 10% of the lagoon area to be occupied by pearl farms and by not granting any more maritime concessions or extensions of existing ones when this limit is reached.

p0630

Another example of external costs arising from intensive exploitation is the use of high pressure hoses to clean the oyster lines on boats on pontoons (e.g., Fig. 14.2): it seems that as a result of these methods, sea anemones which are shredded to pieces and ejected into the lagoon multiply much faster and colonize oysters at neighboring pearl farms as a major component of biofouling. In French Polynesia, this “cost effective” method of cleaning oysters in large-scale pearl farms is viewed as the main cause of the increasing proliferation of sea anemones in the lagoon of French Polynesia.

p0640

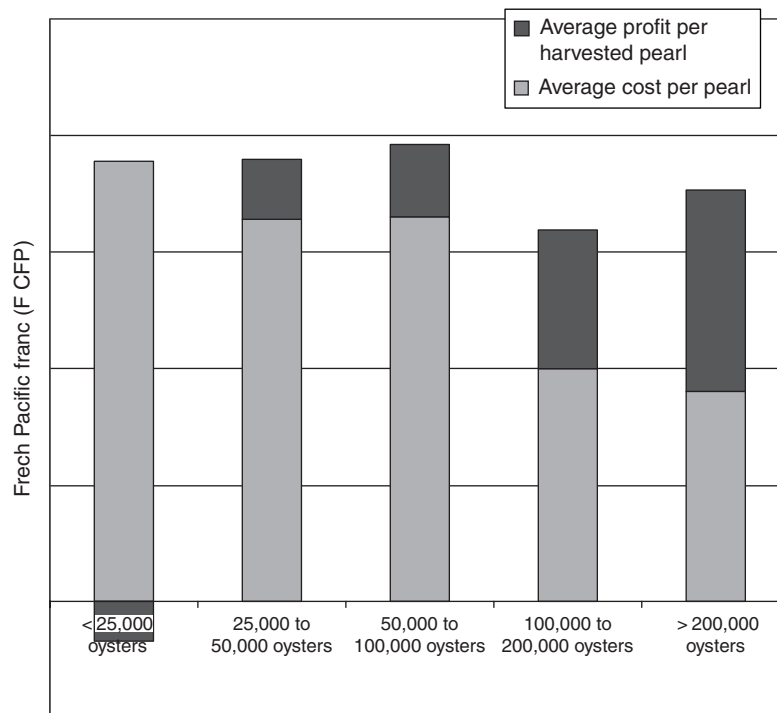
It is very difficult for late entrants to become market leaders in the supply of pearls. It is interesting to observe that market leaders emerging after Japan’s domination of the industry, did so by favoring different species of pearl oysters and by having access to different geographical areas suitable for their culture. Consider the entry of Paspaley Pearls through the culturing of South Sea pearls in Australia and Tahiti Perles via the culture of Tahitian black pearls in French Polynesia. In so doing, they were lucky to profit from the severe downturn of Akoya pearl production in Japan, first from the 1966 to the mid-1970s, then from 1995–1996 to 2000, due to the “Akoya virus”, which encouraged Japanese buyers to look elsewhere for substitutes.

p0650

Another often overlooked advantage of early players in the game is the existence of significant economies of scale, giving a decisive advantage to large-scale farms over small-scale farms. An unpublished study by Kugelmann and Poirine (2003) has shown evidence of such scale economies in French Polynesia. According to their survey, the average cost of harvesting a pearl is halved when the average size of the farms quadruples from 25,000 to 200,000 oysters in stock. In fact, at the time of study (2002), prices were so low that on average the small farms (less than 25,000 oysters in stock) were operating at a loss (note that the study included an estimated opportunity cost of family labor in the economic costs). However, the study found no significant economies of scale beyond 200,000 oysters in stock. The study further showed that the cost of rearing pearls is the most sensitive to size. The average cost of grafting increases and then decreases with size. The other average costs (management, taxes, boats, diving equipment) also tend to decrease with size. The general relationship between average costs and profitability as a function of farm size as illustrated in Figure 13.5.

p0660

In many cases, small producers of pearls, particularly in developing countries, are unable to access world pearl markets economically. Their sales are often made to passing tourists and to middlemen. Because they lack market power and knowledge, the prices they receive may be low compared to those achieved by leading suppliers in the industry.



f0050

FIGURE 13.5 Average cost and profit for different sized pearl farms in French Polynesia (estimated with 2002 prices). The vertical axis is not graduated to preserve confidentiality of the profit and cost figures. Data from Kugelmann and Poirine (2003).

In French Polynesia, the middlemen buy with cash the crops of small producers, at a very high discount, even though small producers have the option to join a cooperative (groupement d'intérêt économique) to sell the pearls through an annual international auction. The cooperatives also routinely complain that small producers sell their best quality pearls to middlemen, leaving the rest of the crop to the cooperative to sell at the auction, with the result that the average quality of lots sold at the auction is not good enough to obtain a reasonable price (personal communication to Bernard Poirine).

13.6.4. Incomes and prices as influences on the demand for pearls

s0100

p0670

As noted above, social factors, advertising and promotion of pearls influence the demand for pearls. In addition, the price of pearls and the levels of income of consumers can be expected to affect the demand for them.

p0680

Few studies of the responsiveness of the demand for pearls to their price and income are available. However, Poirine (Tisdell and Poirine, 2000) estimated the price elasticity of demand for Tahitian pearls and found it to be inelastic (-0.36). Although no estimates are available, demand can also be expected to be price inelastic for Akoya pearls and for South Sea pearls, maybe even more so. The implication of this inelasticity is that an increase in the supply of pearls reduces the total revenue obtained by pearl producers.

p0690

This elasticity figure implies that a rise in the price of Tahitian pearls by 10% reduces demand for them by only 3.6%, everything else unchanged. On the other hand, a reduction in price of Tahitian pearls by the same amount would result in only a gain of 3.6% in the quantity sold. This matter can also be considered inversely. For example, the inverse of -0.36 is -2.7 . This implies that a 10% rise in the supply of Tahitian black pearls would reduce their price on average by 27.7% and consequently cut the receipts of suppliers. In these circumstances, producers of Tahitian pearls would benefit by restricting their supply.

p0700

However, quite a different thing happened from 2002 to 2005 (see Fig. 13.1): the supply of Tahitian black pearls fell by -34.6% , the price per gram went up only by 11%, implying a price elasticity of -3.1 . The Tahitian black pearl now has close substitutes from Cook Islands and Indonesia, therefore the total supply of black pearls is not any more measured by the quantity exported from French Polynesia, so it is difficult now to draw conclusions on the value of price elasticity by looking only at figures from French Polynesia.

p0710

Because the price elasticity of demand for pearls derived from oysters is low, the incomes of pearl producers as a whole can be maintained by limiting their supply. This strategy also increases the long-term rarity value of pearls. Furthermore, because pearls are not a necessity and because of demand features associated with pearls, the public may not be very critical of this restrictive strategy from a social welfare point of view, especially if most buyers are foreign purchasers. In Australia's case, this may be why the Productivity Commission did not recommend a change in Australian policy which limits supply of South Sea pearls, even though hatchery techniques make it possible to increase the production of pearls significantly without depleting the wild stock of oysters (which was the main reason for limiting pearl grafting in Australia in the first place).

p0720

The demand for pearls, especially quality pearls, appears to be sensitive to income levels. Although no empirical estimates of income elasticities of demand for pearls seem to be available, some circumstantial evidence points to this sensitivity. As noted above, Asia is the major global market for pearls. The sharp fall in pearl prices in the period 1998 to 1999 was associated with the Asian financial crisis which reduced incomes for a time in Asia and created economic uncertainty. Again, it seems likely that the rising demand for pearls in China (see Table 13.3) is associated with rising incomes in China. The fact too that pearls are durable and their purchase can be deferred probably adds to the sensitivity of the demand for pearls to income variations.

p0730

No estimates of the cross price elasticities of demand for pearls are available. It was speculated above that their cross elasticity might not be high. This would imply that most consumers do not regard pearls from different species to be highly substitutable. This view is likely to be promoted by large suppliers primarily supplying pearls from a single species. Nevertheless, it is becoming more common for pearls from different species to be incorporated in jewelry (Anon, 2006b). This would foster complementarity in demand of pearls.

s0110

13.6.5. Other marketing aspects

p0740

Pearl auctions and jewelry fairs have become important wholesale outlets for pearls. The Paspaley Pearling Company conducts its own auctions as does Robert Wan's Tahiti Perles. Auctions are held in Hong Kong and Japan. These auctions help the major suppliers to gauge the market and, to some extent, control the price by setting reserve prices. If batches of pearls do not reach the reserve, a price may be negotiated with interested buyers following the auction or supply may be withheld (Anon, 2006a). The system opens the buying side of the pearl market to competition. However, small suppliers may find it difficult to access such opportunities for selling their pearls. Nevertheless, one Polynesian cooperative of small producers (GIE Poe Rava Nui), which held annual auctions in Papeete, is now considering holding its annual auction in Hong Kong.

p0750

As mentioned above, many small producers in developing countries rely on passing tourists and on middlemen to sell their pearls. They are at a disadvantage in accessing international markets and their pearls are likely to obtain a lower price than those supplied by large producers for several reasons outlined above. Small producers in developing countries are likely to be in a better position to market their pearls locally if there are skills in producing jewelry locally (Southgate *et al.*, 2006). This increases value added locally and can foster indirect employment.

p0760

This problem is recognized by Fong *et al.* (2005) who point out that a small-scale pearl farm may not compete well in the global pearl market with larger producers. They (Fong *et al.*, 2005) recommend that:

“farms in the Central Pacific may consider forming production and/or marketing cooperatives and/or partnerships to share resources to reduce monetary and non-monetary costs. Further, farms may consider different product differentiation strategies such as co-branding with wholesale/retail operations, mechanisms to ensure only high quality pearls enter the international market, and implement best management practices and use it as a marketing tool.”

p0770

Even in more developed countries, tourists are targeted for pearl jewelery sales both generally and when they visit areas associated with pearling. In Australia, there are several pearl museums for example, one in Darwin and another in Broome. These provide background on the pearl oyster industry and promote it. They also sell some pearl jewelery. Some pearl farms have also supplemented their income by visits from tourists, such as the farm of Atlas-Pacific Ltd in Bali, Indonesia which is estimating to expand its pearl tourism operations (Fassler, 2006). While pearl-based tourism can be profitable for a pearl farm in a suitable location, it is not without costs. Each situation has to be individually assessed to decide whether pearl farm visits by tourists are likely to be profitable to a particular farm.

s0120

13.7. SUMMARY

p0780

The structure and nature of the cultured pearl industry shows variation between countries in which it has developed. This was illustrated by differences between the Australian industry, that of French Polynesia and the industry in the Cook Islands. Production is highly concentrated in Australia in very few hands. While industry concentration is also evident in French Polynesia, many small producers exist unlike in Australia. In the Cook Islands, a symbiotic or cooperative arrangement has evolved between small suppliers and a substantial producer and trader. Cultural and historical factors may help to explain the differences. However, developments in technology and wider access to it have and continue to play a role in shaping the structure of the industry which on a global scale appears to be bipolar.

p0790

On the production side, there is evidence of economies of scale which tend to favor larger production units. Furthermore, economies of size seem likely to be very marked in the global marketing of pearls. Large producers have integrated the production and marketing of their pearls and to a considerable extent are working these to add value to them. While smaller producers may be able to access local markets to sell their pearls and related products, they face difficulties in accessing global markets on their own. In French Polynesia, cooperative selling arrangements are being developed to reduce these barriers and standards are being set that must be met by exporters of pearls. An alternative strategy is for small producers to sell to a larger trader, as in the Cook Islands, who markets the product. As pointed out, pearls are not a standard product. The demand for them depends on their perceived social value and the image surrounding them. Keeping pearls scarce, particularly quality pearls, can add to their social worth.

p0800

In Australia, the supply of South Sea pearls is restricted by a quota system and presumably, the major Australian players try to limit supplies from other countries by obtaining leases etc. and buying unworked South Sea pearls from these sources. Sustaining the price of South Sea pearls requires supplies from new sources to be limited. On the other hand, supplies of black pearls have not been restricted in French Polynesia, and supplies have increased from other countries, such as the Cook Islands, in recent years. This has been a factor in the fall in the average price of black pearls in

recent times. The demand for black pearls from French Polynesia is now more elastic than it used to be because of competition from other countries.

p0810

The market shares of pearls from different species of pearl oysters have changed considerably in recent decades, as have the shares of the main countries producing cultured pearls. In terms of the value of market shares, South Sea pearls have the highest share, followed by freshwater pearls, Akoya pearls and the black pearls. In previous times, Akoya pearls dominated the global pearl market, and gave Japan the dominant position in it. However, the Akoya virus cut Japanese pearl supplies and Japan had to search for alternative sources of supply. For example, joint ventures to culture South Sea pearls began in Australia. This helped to diffuse Japanese know-how and helped raise demand for pearls obtained from other species of oysters. Also, in earlier times, Japan had a dominant position in the freshwater pearl industry but as a result of water pollution in Japan, particularly in Lake Biwa, many freshwater mussels failed to survive. So, Japan moved some of its production offshore to other countries, such as China. This, together with the opening up of China to the outside world, resulted in China gaining a dominant position in the production of freshwater pearls. To some extent, environmental problems experienced in Japan assisted the global diffusion of Japanese technology for pearl culture and played a role in the changing geographical location of pearl culture and the altered composition of pearls marketed. This, however, is only part of the story because many different factors have played a role in the evolution of the pearl oyster industry.

p0820

On the socio-economic side, it was found that in some countries, substantial numbers of small-scale producers of pearl oysters have been able to survive economically. However, they are at an economic disadvantage compared to large producers. A positive feature of the industry is that it fosters decentralization and provides economic opportunities in remote areas. Sometimes, however, these opportunities are only realized by locals working for larger oyster producers, by the locals engaging in value adding by for instance, producing and selling jewelery, or being involved in the tourist trade centered on the culture of pearls. Interesting examples of such activities were given for French Polynesia. In Australia, the pearl oyster industry appears to be much more capital intensive than in the Pacific islands. While pearl culture does provide employment and sources of extra income in remote areas of Australia, its production appears to be less integrated with local communities, except in very few centers such as in Broome, than in the Pacific islands. Pearl farming in Australia has more of an industrial element than in other countries and the grow-out of Australian pearl oysters often occurs well offshore and consequently rather distant from settlements onshore. Thus little interaction often occurs with the nearest onshore settlements.

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