

By **RIY Adan**

Pearl aquaculture is fast becoming a promising and sustainable form of economic activity. Governments are assessing their water resources, both marine and freshwater as pearl farming can be accomplished in either, so long as it is clean and clear.

The simplicity of the pearl makes it one of the most enduring of jewels. Yet, it would be erroneous to conclude that the process of making a pearl is similarly simple. In fact, part of the pearl's mystic lies in the fortuitous way pearls are produced. Pearls were solely a lone act of nature before but through time, man has slowly learned the secret in assisting nature in producing these jewels. However, nature's hand is not completely eliminated, for only she alone determines the character of any potential pearl.

The first practical work to produce pearls artificially was done by the Chinese in the 13th century, producing the classical pearly Buddha images in the freshwater mussel in Lake Tahu in central China. However, the credit for the development of modern pearl culture goes to Japan. The Japanese have succeeded in evolving a method of culturing perfectly spherical pearls; although there is a controversy as to who exactly among them did it. It appears that credit for the achievement should go to Mise and Nishikawa although it was Kokichi Mikimoto who established an industry for cultured pearls, earning the title of "Pearl King." Pearl culture then spread, with Japanese assistance, to Australia, Papua New Guinea, Philippines, Burma, Thailand, Malaysia, and Indonesia.

### Pearl formation and various pearl types

Pearls are produced from pearl oysters both in seawater and freshwater (see table).

There are essentially three types of pearls: natural, cultured, and imitation. A natural pearl (often called an Oriental pearl) forms when an irritant, such as a piece of sand, works its way into a particular species of oyster, mussel, or clam. As a defense mechanism, the mollusc secretes a fluid called nacre which coat the irritant. Layer upon layer of this coating is deposited on the irritant until a lustrous pearl is formed.

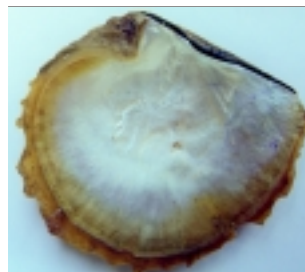
A cultured pearl undergoes the same process. The only difference is that the irritant is a surgically implanted bead or piece of shell called Mother of Pearl. Often, these shells are ground oyster shells that are worth significant amounts of money in their

Common / English name	Scientific name
<b>SEAWATER SPECIES</b>	
"Akoya" pearl oyster	<i>Pinctada fucata</i>
Silver-lipped pearl oyster	<i>Pinctada maxima</i>
Black-lipped pearl oyster	<i>Pinctada margaritifera</i>
"Mabe" pearl oyster	<i>Pteria penguin</i>
<b>FRESHWATER SPECIES</b>	
"Ikecho" mussel (Japan)	<i>Hyriopsis schlegeli</i>
"Sankaku" mussel (China)	<i>Hyriopsis cumingii</i>
"Karasu" mussel (China and Japan)	<i>Cristaria plicata</i>

own right as irritant-catalysts for quality pearls. The resulting core is, therefore, much larger than a natural pearl. A few years ago, producers successfully implanted as many as four beads or irritants in one oyster, and still produced high quality pearls.

Pearls can come from either salt or freshwater sources. Typically, saltwater pearls tend to be higher quality, although there are several types of freshwater pearls that are considered high in quality as well. Freshwater pearls tend to be irregular in shape, with a puffed rice appearance the most prevalent. Nevertheless, it is each individual pearl that determines value more than the source of the pearl.

Regardless of the method used to produce a pearl, the process usually takes several years. Mussels must reach a mature age, which can take up to 3 years, and then be implanted



Two of the three types of pearl oysters cultured by a people's cooperative in Guimaras island, west central Philippines



## Community-based pearl farming

Pearl culture not only presents opportunities for foreign exchange earnings but also economic advancement of coastal communities.

The Guimaras Compressor, Operators and Divers Multi-purpose Cooperative now experiences this. The group, headed by Noel Infante of Sabang Sibunag in the island of Guimaras, used to fish and culture lobster for their main source of income. But three years ago, they came across some pearl oysters in their waters and found irregular pearls in some. This prompted them to approach the Department of Science and Technology (DOST) and request for pearl culture training.

“That started everything,” said Delia Tabanao, DOST Regional Coordinator for Guimaras. Neri Adventur from another DOST field office surveyed the site and trained the 25 members of the cooperative on how to implant irritants and beads, and the proper culture techniques. Luckily too, the cooperative was well supported – in terms of financial, technical and management aspect - by DOST and the Guimaras provincial and local government units.

The group uses three species of pearl oyster: the *wasay-wasay* (*Pteria penguin*) which is fast growing and produces a pinkish pearl; *tipay-bato* (*Pinctada margaritifera*) which produces the black pearl and *tipay* (*Pinctada maxima*) which produces the famous and expensive South Sea Pearl. They focus on *tipay* as this demands a higher price.



Ms. Delia Tabanao, the government science and technology coordinator for Guimaras province

They used to buy their irritants from the US but now, they have a supplier from Zambales, northern Philippines. At present, the group is producing half moon or blister pearls only – as they have not yet perfected the technique of inserting irritants in the gonads, which results to round pearls. Nevertheless, they already have a ready market for their produce – despite its small quantity (limited to only 150 pearls a month). Blister pearls are ready for harvest after 8 months to one year. Moreover, rejected shells are converted to souvenir items and some are made into plaques, shellcraft-making being another activity the group undertakes.

“Pearl culture in the area indeed has a very good potential,” said Tabanao, “but it’s not environment-friendly since stock are extracted from the wild. The cooperative is already looking for technology to produce their own oysters to avoid depleting the natural stock.”

On the other hand, the group which was impatient at first to harvest their pearls before these are even harvestable, has already learned the value of patience. They are interested and more enthusiastic with their project, now that they have sold the first batch of pearls.

Tabanao concludes: “Pearl culture is very feasible for coastal communities – but not as a major source of income. They still need other forms of livelihood to tide them over while waiting for the pearls to grow.”

And as they say: Patience is the name of the game. -- RIIA

or naturally receive an irritant. Once the irritant is in place, it can take up another 3 years for nacre to coat the irritant and for the pearl to reach its full size. Often, the irritant may be rejected, the pearl will be misshapen, or the oyster may simply die from disease or countless other complications.

By the end of a 5 to 10 year cycle, only 50% of the oysters will have survived. And of the pearls produced, only approximately 5% are of substantial quality for top jewelry makers. From the outset, a pearl farmer can figure on spending over \$100 for every oyster that is farmed, of which many will produce nothing or die. However, technological advances and thorough understanding of pearl culture have made pearl culture easier to manage.

Imitation pearls are a different story altogether. In most cases, a glass bead is dipped into a solution made from fish scales. This coating is thin and may eventually wear off. One can usually tell an imitation by biting on it. Fake pearls glide across your teeth, while the layers of nacre on real pearls feel gritty. The Island of

Mallorca is known for its imitation pearl industry.

Pearls also come in many colors. The most popular colors are white, cream, and pink. Silver, black, and gold are also gaining increasing interest. In fact, a deep black pearl is becoming popular. Tahiti produces by far the most black pearls, though culture also goes on in Fiji, New Zealand and Japan. At present, black pearls dominate over white ones in Japan. Black pearls were not favored by Western buyers, but are gradually becoming popular due to their large variety of color. The soft gray pearls are especially in demand now.

Among cultured pearls, “Akoya” pearls from Japan are some of the most lustrous. A good quality necklace of 40 pearls measuring 7 mm in diameter sells for about \$1,500, while a super-high quality strand sells for about \$4,500. The South Sea pearls of Australia, Myanmar, and Indonesia are rarer and larger, with diameters of 10-20 mm, and cost far more even though they tend

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to be less lustrous. A 16-inch strand of white South Sea pearls retail for \$40,000 to 50,000.

The world record for the highest price paid for a cultured pearl necklace was \$2.3 million at Sotheby's in 1992. The 17-inch strand had 23 pearls with diameters ranging from 16 to 20 mm (about the diameter of a dime), with a bead-shaped platinum clasp with 60 round diamonds.

### Quality improvement

The quality of pearls determines its economics. The size, shape, color and luster determine the quality and value. Apart from the bulk rates by weight, individual pearls of exceptional quality would command special premium price.

The quality of cultured pearls can be determined and improved through appropriate care at surgery and farming. Size and shape can be better controlled at surgery. But color and luster can only be improved if the oyster biology and physiology and farm conditions are understood.

The luster of pearl is due to two sensations of light, namely 'lustre' and 'iridescence', and is brought about by the absorption and reflection of the waves of incident light. The nacre is composed of several concentric layers of mineral lamellae of aragonite, each layer with a thickness of 0.29-0.60  $\mu\text{m}$ . Conchiolin forms the organic matrix on which the aragonite crystals are laid and the layers bound. Homogeneity, thinness and smoothness of these layers are responsible for the pearl's luster. Minerals and trace elements in the seawater and the chemical composition of the phytoplankton components also influences the color of pearls. The abundance and quality of phytoplankton in pearl culture grounds determine the state of nutrition of the oyster.

Depth also affects the quality of pearls; those that are produced in deeper water, beyond 10 m, are observed to be of high quality. Fouling and boring problems are insignificant at depths below 10 m as compared to the subsurface waters.

Temperature generally controls the metabolic rate of the molluscs. Higher temperatures lead to faster growth of oyster and also higher rate of deposition of nacre. While this hastens production, the quality would suffer. Thinner laminar nacreous layers which result from lower temperature are more desirable than the thicker layers resulting from higher temperature, at least in the later phase of culture. Therefore, pearl harvest should be done during low temperatures. The pH should also be low.

The ecology of the culture grounds should therefore be thoroughly understood. Japanese pearl culturists shift the rafts from region to region seeking grounds of better conditions during the last phase before harvest. Several old pearl culture grounds are abandoned as culture in the same ground year after year results in poor quality of pearls. Alternation of grounds is considered important. Areas of pollution should also be totally avoided.

On the other hand, the quality of donor oysters also influence the quality of the pearl. Utmost care should be taken in selection of donor oysters and in the process of nucleus implantation.

Pearls produced in the ventral gonad region are generally superior. Pearl-sacs are formed within or in contact with the hepatopancreas produced largely grey colored pearls, though good cream colored pearls may also be produced. Pearl-sacs growing in the gonad region should be free from contact with other organs such as intestine, hepatopancreas, pedal retractor muscle and the byssal gland.

### Distribution and market trends

#### *World market for loose cultured pearls (1997)*

EXPORT		IMPORT	
Australia	30.44%	Japan	67.01%
French Polynesia	25.93%	Hong Kong	11.39%
Indonesia	8.35%	USA	8.67%
Japan	11.17%	Germany	2.90%
Others	24.10%	Others	10.03%

#### *World market for worked cultured pearls (1997)*

EXPORT		IMPORT	
Japan	48.6%	USA	33.81%
Australia	12.0%	Hong Kong	15.40%
Hong Kong	8.2%	Germany	10.03%
French Polynesia	7.6%	Switzerland	7.46%
China	7.6%	Others	33.30%
Others	16.1%		

Pearls predominately come from Japan, Australia, Indonesia, Myanmar, China, India, Philippines, and Tahiti. Japan controls roughly 80% of the world pearl market, with Australia and China coming in second and third, respectively. The waters around Australia, Indonesia, and Myanmar are renowned for their large, white pearls; Japan for their lustrous pearls; and India for their natural pearls.

China, on the other hand, produces the bulk of the world's freshwater pearls. In fact, suppliers have urged for the moderation of production lest it leads to the industry's self-destruction because of overproduction. Meanwhile, Japan's freshwater pearl industry - rendered extinct by population in 1985 - is showing signs of rebirth.

The market size of pearl jewellery in retail value in 1999 reached US\$4.5 billion. Although demand in Japan and South-east Asia has been affected by the economic crisis over the past two years, the region continued to lead in pearl jewellery sales, with a spending of more than US\$1.8 billion on pearl jewellery.

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The United States has grown to become the single largest pearl jewelry consumer, purchasing US\$1.47 billion, or 36% of the global pearl jewelry sales. Europe, which accounted for only a small fraction of the pearl market five years ago, is seeing its market share expand at a tremendous pace, with wholesalers reporting substantial growth year after year. The European pearl jewelry market is estimated at US\$700-900 million. Meanwhile, Tahitian cultured pearl exports are expected to exceed 7,000 kg in 2000. Annual reports of Tahitian pearls were about 5,000 kg in 1996 and 1997; and more than 6,000 kg in 1998 and 1999. The Philippines, on the other hand, continues to establish itself in the international pearl market with exports increasing 22.8% to 586,665 g or 156 kg in 1999 compared with 1998.

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Lucinidae) that harbors symbiotic bacteria. This shell family has also been observed to live in hydrogen sulfide-rich habitats such as sewage outfalls, seagrass beds, mangrove swamps, and in organically rich sediments.

This means, researchers say, that *imbao* harbors symbiotic sulfur-oxidizing bacteria in its gills and has the mechanism within itself to use up sulfide. This capability would make *imbao* useful if raised in polyculture with shrimp. It is a fact that brackishwater pond sediments contain plenty of sulfide, particularly where the cultured animals are fed protein-rich diets. *Imbao* can very well answer this problem – and make aquaculture more environment-friendly.

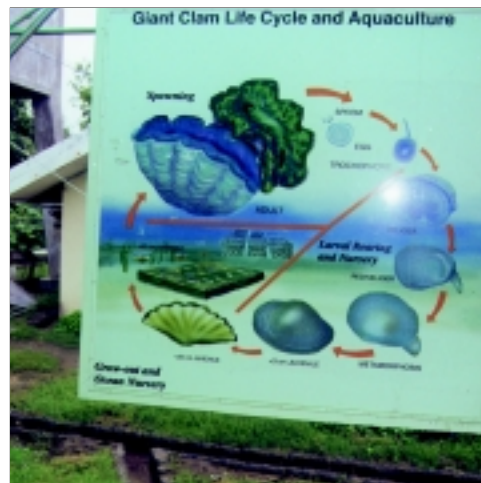
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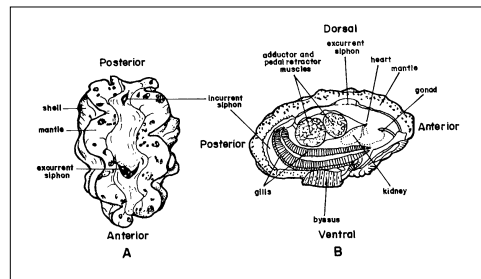
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clams are popular for export. But it is important to note that in order to produce meat biomass and supply the adductor muscle/mantle markets, time for which capital and resources are tied up prior to sales is lengthy, thus quick returns are not possible.

In Australia, farm-gate price of fresh clam meat ranges from \$A3 to 7. In 1986, it was reported that Taiwan demand for adductor muscle of 100 ton/yr was at \$US 7.50 - 21.25/kg.



The giant clam life cycle shows its stages of development



The parts of the giant clam shows the adductor muscle which is the most valuable part of the clam for export purposes. The adductor muscle is highly priced in Japan for sashimi and fetches a good price

## Conclusion

Experts say that the giant clams (nearing extinction in most parts of the world) are attractive to farm for economic, social, and ecological reasons because of their innate characteristics - self-feeding, sedentary habit, adult resistance to predation. Besides, technology for its mass production from breeding to harvest has been proven successful in many parts of the Indo-Pacific. But its development as an industry is difficult to appreciate considering the duration that capital is tied up to production. Perhaps its importance lies not so much on its promise for immediate profits but on its ecological importance to coasts worldwide. Resembling big trees in primary forests, their importance cannot be measured immediately but their contribution is far-reaching and simple, one fails to see it. As in most ecological issues, the profit is promised for the coming generations. ####