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Pearl Farming as a Sustainable Development Path

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For centuries, wild pearl oysters and mussels were fished in the quest for natural pearls and shell material. This eventually led to the drastic overexploitation of oyster stocks in many areas of the globe.¹ Scientific innovation and entrepreneurship eventually unearthed a solution: Researchers discovered a way for humans to farm pearl oysters and induce the formation of a cultured pearl. A century after this discovery, many pearl farming regions are vulnerable to climate change and coral and coastal habitat destruction. Pearl farming might provide a win-win opportunity for such communities.

Overcoming Biodiversity Loss

At present, marine biodiversity is facing huge threats in the Pacific region as a result of climate change, overfishing, and unregulated coastal development.² The preservation and conservation of marine resources have become a priority in many areas and regions. Corals and fisheries are the basis for functioning marine ecosystems on which humans rely for food and well-being, and these ecosystems must thus be preserved and rebuilt.^{3,4} Conservation biologist Joe Roman and colleagues have argued that “in the long run, the most effective forms of conservation will be those that engage local stakeholders; the cultivation of sustainable ecosystems and their services must be promoted along with conservation of endangered species and populations.”⁵ There is ample evidence that for conservation to work it needs to also provide tangible benefits for local communities.⁶

Clearly, great opportunities lie in combining the conservation of marine biodiversity with viable economic activities for local people in order to preserve highly sensitive ecosystems.⁷ Given that cultured pearl farming is one of the few economic activities in which sound environmental management and conservation are a prerequisite to economic success, the sector offers some interesting insights with regard to sustainability in the marine realm. In Mexico, pearl oysters of the species *Pinctada mazatlanica* and *Pteria sterna* were declared in danger of extinction and put under protection in 1940. This was the first marine conservation measure in Latin America.⁸ Could pearl farming today promote environmental conservation by providing financial incentives that are frequently lacking in environmental conservation projects?⁹

An Introduction to Pearl Farming

The production of a cultured pearl is a complex process that requires a thriving marine ecosystem, important knowledge and skill, and several years of patience. In Australia, pearl farmers can collect wild adult oysters under a strict quota system. Otherwise, young oysters can either be collected as spat from the wild during natural spawning seasons, using artificial collectors, or be artificially spawned in hatcheries. Two to three years after the birth of an oyster, it can be seeded, an operation during which a nucleus and mantle tissue are implanted to induce the formation of a cultured pearl. After this, the nucleus is gradually covered with nacre (mother-of-pearl) by the oyster. This period of growth of a cultured pearl takes a further one to two years, depending on a range of factors. From birth of the oyster to the harvest of the pearl usually takes at least three to four years.

Not all oysters will survive, and not all oysters will produce a beautiful pearl. Estimates suggest that 95 percent of a pearl farm's income comes from 2 percent of its pearls.¹⁰ The skills of the seeding technician play one important role. Environmental deterioration or sudden ecological changes will also affect the oyster and hamper its potential for producing a high-quality pearl, as pearl oysters are remarkably sensitive organisms. Consequently, financial and ecological sustainability are intimately and inextricably linked.¹¹ The more pristine an environment, the healthier the

oysters are and the higher the likelihood of harvesting valuable, high-quality pearls. Ultimately, for a pearl farmer, it pays to maintain a thriving ecosystem.

Using Local Resources and Promoting Natural Capital

Despite procedural challenges, pearl farming can be one of the most profitable forms of aquaculture and may be carried out in isolated islands where there are otherwise very limited economic opportunities.¹² Cultured pearls have become important economic pillars in French Polynesia and the Cook Islands as main sources of export revenue. In French Polynesia, pearl farming has reduced pressure on fish stocks, stemmed outer-island emigration, and provided economic alternatives for an economy otherwise heavily reliant on French financial assistance and tourism. At its peak in 2000, the pearl sector provided employment to 7,000 people in French Polynesia.¹³ In the Cook Islands, black pearl production can be carried out within existing forms of indigenous socioeconomic organization.¹⁴ Other small island developing states in the Pacific have attempted to emulate these successes and tried to establish pearl farming operations, but most have failed to sustain the production of commercially viable pearls at a community level.¹⁵

A recent and tentative success story is in the Federated States of Micronesia where a community pearl farming project has been envisaged as a model for combining marine conservation and community development, thereby providing economic opportunities using local resources. There, a new integrated marine plan is being implemented in which pearl farming complements lost income that artisanal reef fishing communities have to incur due to the introduction of no-fishing zones and marine protected areas. This new source of income has created an incentive for conservation by reducing pressure on reef fish stocks, and it is increasing the resilience of these communities in the face of climate change. This reflects findings of a recently published United Nations Environment Programme report on the green economy that revealed that "there is a clear link between poverty eradication and better protection and restoration of habitat, marine fishery resources and biodiversity."^{16,17}

Maximizing Revenue: Emphasis on Quality and Innovation

The business of selling cultured pearls has become challenging for many pearl farmers. With the effects of the 2008 global economic crisis, issues of high production and changing demand, fragmentation both at a supply and distribution level, and rising competition from Chinese freshwater cultured pearls, the marine cultured pearl industry finds itself in a difficult business environment.¹⁸ In French Polynesia, a number of pearl farmers who worked farms of varying size have gone out of business in recent years. The average price of exported pearls from French Polynesia has been divided by four in the past decade. This price decline can be explained by overproduction, a reduction in the average quality of pearls produced, and a host of other market factors.¹⁹ However, research has shown that prices for large, high-quality cultured pearls have not dropped.²⁰ A pearl farm with a focus on quality pearls produced through responsible farming practices still very much has its place in the international market. Demand for cultured pearls should be strengthened by creating further incentives for luxury consumers. Pearls could be marketed as a sustainable alternative in an increasingly ecologically conscious jewelry market.

Nevertheless, the revenue streams of pearl farmers are changing and diversifying beyond the simple sale of pearls.²¹ Ecotourism that allows for direct purchase of raw pearl, jewelry, and culinary products is one option, although the remoteness of some destinations like Micronesia and Polynesia limit this avenue.

Another option is to explore the additional uses of oysters beyond the pearls they produce. Historically, oyster shells were used in button manufacturing. Today, shells are again in demand for furniture and ornamental purposes. A pearl oyster shell consists of 95 percent calcium carbonate. Ground and purified, it can be used for medicinal purposes in relieving osteoporosis,²² in bone replacement therapy,^{23,24} as a source of calcium for dietary supplements,^{25,26} and in beauty products. The properties of the oyster shell's periostracum (the outer, organic-rich layer of the shell) have even been investigated for military and maritime uses.²⁷ Adductor muscle meat of pearl oysters is frequently sold for human consumption and the dried meat of the oyster is being used to enrich soils in certain countries, such as the United Arab Emirates. Clearly, these many different uses provide opportunities for pearl farmers to diversify their sources of revenue and allow them to minimize resource waste.

Pearl oysters have also been investigated for environmental remediation based on their filtering abilities. They are among the filter-feeding marine organisms with the highest clearance rates. A single *Pinctada margaritifera* oyster in French Polynesia can filter between 11.5 and 25.9 liters per hour per gram of tissue dry weight, thereby serving as an important buffer and regulator of water purity and quality.²⁸ Pearl oysters have been investigated as a tool for heavy metal remediation in coastal ecosystems in Australia, with a study showing that pearl oysters could assist in the removal of pollutants from coastal waters while producing commercially viable cultured pearls.²⁹ Thus the oysters could also provide an ecosystem service that should be accounted for in cost-benefit analyses of different

possible development paths. Given that pearls are a saleable good themselves, their price could be calibrated to account for the services they provide. Such an approach provides a means of internalizing a market for ecosystem services through a particular product (thus circumventing the usual “market absence” critique of payment for ecosystem services approaches).

Furthermore, the ocean is the world’s largest carbon sink and is an important regulator in global carbon storage, sequestration, and release. It is estimated that “the most crucial, climate-combating coastal ecosystems cover less than 0.5 percent of the sea bed. These areas, covering features such as mangroves, salt marshes, and seagrasses, are responsible for capturing and storing up to some 70 percent of the carbon permanently stored within the marine domain.”³⁰ The ecosystem services provided by pearl farmers are further reaching than the conservation of sensitive corals and fisheries. They could play a growing role in the management of “blue carbon.” Pearl farming in the Federated States of Micronesia and the United Arab Emirates is carried out in coastal mangrove ecosystems, which are protected by the pearl farmers because their oysters are dependent on the nutrients provided by the mangroves. Such pearl farms would be ideal candidates to qualify for funding from a future blue-carbon credit-trading scheme.

Conclusion

At present, within pearl farming, the difficult business environment presents an obstacle to promoting sustainability. But consumer demand could increase the sustainability benefits the sector provides to coastal communities and ecosystems. Responsible consumer choice for pearls as a jewelry product rather than other gemstones should be further encouraged. Scientists need to conduct more research into understanding how marine pearl farming’s potential in marine conservation and restoration can be extended and to find better ways of cohabiting and engaging with nearby fishing communities.

Ultimately, traders and consumers of pearls could further strengthen the livelihoods of pearl farmers and the positive ecosystem services they provide. Consumers of jewelry should be made aware of the positive synergies that lie in the process of cultivating marine pearls. Indeed, if the farmers who operate in the waters of the Pacific do not prosper, the ecosystem services provided by these waters will cease to exist.

As a model of private entrepreneurship in small island developing states (e.g., Fiji, the Federated States of Micronesia, and French Polynesia), pearl farming has modestly emerged as an economic activity that can offer alternatives in a time of climate change. It can offer many valuable lessons for development opportunities in remote coastal communities. It also provides evidence that marine conservation can be integrated within a viable economic activity leading to sustainable long-term growth in vulnerable Pacific environments.

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