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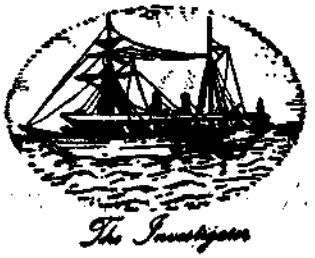

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A CRITICAL REVIEW OF PROGRESS AND PROBLEMS OF PEARL CULTURE IN INDIA

K. ALAGARSWAMI

Central Marine Fisheries Research Institute, Cochin 682 018

ABSTRACT

A major breakthrough was achieved when techniques for the production of cultured pearls in the pearl oyster *Pinctada fucata* were successfully developed for the first time in 1973 at the Central Marine Fisheries Research Institute. Since then progress has been made in several biological and technical areas of pearl culture. Training programmes have been conducted to extend the know-how to the maritime States and Union Territories.

The paper recapitulates the recent achievements in pearl culture in India and identifies the areas which require a major thrust to strengthen the technological base. It also outlines the immediate prospects for the development of a pearl culture industry in the country.

INTRODUCTION

THE PEARL culture industry of the world owes its origin and development to Japan where it started with the initial success of late Kokichi Mikimoto in the production of a few half-pearls in 1893. The industry in Japan, based on the species *Pinctada martensii* (= *P. fucata*), became firmly established by 1926 with the production and marketing of spherical pearls and a pre-war peak production of 4 tons was achieved in 1938. The production suffered during the war only to prosper again after 1948 and an all-time record production of 130 tons of cultured pearls was achieved in 1966. Since then the production has declined due to several factors. Cahn (1949), Alagarswami (1970), Shirai (1970), Furukawa (1972), Wada (1973) and Mizumoto (1979), among others, have dealt with the story of pearl culture in Japan.

The first pearl culture farm outside Japan was established in Australia in 1956 and it has become the second important country for the production of cultured pearls. The Australian production, which is based on the silverlip pearl oyster *Pinctada maxima*, was 107,777 numbers of round pearls, 62,179 baroques, 413,964 half-rounds and 161.7 tons of pearl-shells in the year 1971. Franklin (1973) and Hancock (1973) have briefly described the pearl culture industry of Australia. Papua New Guinea has a few pearl culture farms in Fairfax Harbour (DEA, Canberra, 1970). A moderate pearl culture industry, using *P. maxima*, *P. margaritifera* and *Pteria macroptera*, exists in the Philippines (Blanco, 1972). Malaysia, where pearl culture began in Sabah in 1963, has a small-scale industry producing about 50,000 half-round pearls in *P. margaritifera* (Fisheries Division, Malaysia, 1972). Thailand has a very moderate pearl culture industry along the Andaman Sea Coast based on *P. maxima* and *Pteria macroptera*. Burma's pearl culture operations using *P. maxima* are located in the Mergui Archipelago. Indonesia has had mixed success with *P. maxima* in Butung island at the southern end of Celebes (Shirai, 1970).

Pearl culture has also spread to Hong Kong, Korea and Fiji Islands. A project was established in Sudan a few years ago for production of cultured pearls in *P. margaritifera* (Reed, 1965). It is seen from the above account that pearl culture industry is confined to the Indo-Pacific region.

Interest in pearl culture in India dates back to 1913-14 when late James Hornell drew up a scheme for the establishment of a pearl oyster farm at Krusadai at the head of the Gulf of Mannar. The experiments which were actually started there in 1933 and continued intermittently over a period of about three decades, yielded some basic data on the rearing of pearl oysters under captivity but failed to produce the techniques for the production of cultured pearls (Devanesan and Chidambaram,1956; Devanesan and Chacko, 1958). Experiments taken up later from 1956 at Sikka in the Gulf of Kutch also were not successful (Pandya, 1974). A breakthrough was achieved in 1973 in pearl oyster farming and production of culturedpearls in the Indian pearl oyster *Pinctada fucata* (Gould) at the Central Marine Fisheries Research Institute which started the experiments at Tuticorin in 1972 (Alagarswami, 1974 a). Alagarswami (1974 b) and Alagarswami and Qasim (1973) have indicated the prospects of pearl culture in India.

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Recent Developments in Pearl Culture in India

Pearl oyster resources

The species of pearl oyster which is of primary importance is *Pinctada fucata* (Gould), formerly referred to as *P. vulgaris*. The species contributes to the natural pearl fisheries of the Gulf of Mannar and Gulf of Kutch. Hornell (1922) produced a treatise on the Indian pearl fisheries of the Gulf of Mannar and Mahadevan and Nayar (1968, 1973) have added more recent information on the ecology of pearl banks and pearl fisheries. Easwaran *et al.* (1969) have described the pearl fisheries of the Gulf of Kutch. The pearl oyster resources of both the regions are well known for their wide fluctuations. After a successful series of pearl fishery from 1955 to 1961 yielding an estimated 86 million oysters, the Gulf of Mannar beds have entered the unproductive cycle. The Gulf of Kutch fishery which is very subdued in magnitude producing an average of about 17,000 oysters per fishery conducted every three or four years, has also not revived after the fishery of 1966.

Alagarswami and Qasim (1973) have indicated the presence of pearl oysters in the beds of Gulf of Mannar which provided the initial material of 2,742 oysters during 1972-73 for the pearl oyster farm at Veppalodai near Tuticorin. From this scarce situation it was possible to step up the collection from the natural beds in the gulf to a total of 49,028 pearl oysters, of which 27,730 were *P. fucata*, during the years 1975-1978 (CMFRI, 1979). Signs of slow but steady revival of *P. fucata* populations have been observed during the above period at least in some of the beds. Alagarswami (1977) has discussed the problem of larval transport and settlement of pearl oyster in the Gulf of Mannar. It is probable that the revival noticed in some of the shallower beds such as Devi paar is due to the farming of pearl oysters in the nearby Veppalodai area (CMFRI, 1979).

An interesting phenomenon noticed with regard to the pearl oyster resource is the settlement of pearl oysters in the inshore waters including harbours. The breakwaters of Tuticorin Harbour constructed in 1972-73 were found colonised by the pearl oysters in 1974 (Alagarswami, 1977). Spatfall was observed in the fishing harbour under construction at

Vizhinjam near Trivandrum which has led to the collection of spat on a regular basis although natural beds of pearl oysters have not so far been located in this region (CMFRI, 1974).

However, in both the harbour areas the pearl oyster populations consist of a number of *Pinctada* species including *P. fucata*, *P. sugillata*, *P. chemnitzii*, *P. anomioides* and *P. margaritifera* (Alagarswami, 1977). Incursions of *Pinctada* species, other than *P. fucata*, on the natural beds of Gulf of Mannar were also noticed for the first time in 1975. Constituting 34.3% of the total collections in 1975, the non-*fucata* component increased to 67.5% in 1976 and declined to 50.6% in 1977 and to 15.3% in 1978 implying the transient nature of this population on the natural beds (CMFRI, 1979).

A preliminary resources survey carried out by the Central Marine Fisheries Research Institute in 1978 in the Andaman and Nicobar Islands has shown the occurrence of the blacklip pearl oyster *P. margaritifera* in moderate quantities in the islands. This is a potential resource for pearl culture which needs development.

Attempts have been made for the collection of spat in the farm areas at Veppalodai and Tuticorin harbour basin. Although spat of the non-*fucata* species could be collected in the inshore farms, *P. fucata* spat are very rare. It is likely that the larvae of *P. fucata* are more sensitive to the turbid conditions of the inshore waters and show preference to clear waters for settlement. *P. fucata* component is getting gradually reduced in the Vizhinjam Bay as the silt load is increasing.

Hatchery production of seed, in the light of the above situation, is of great importance. The initial experiments in this direction have provided the techniques for the controlled spawning of pearl oyster and rearing of larvae upto early veliger stage.

Pearl culture technology

The techniques for the production of free, spherical cultured pearls in the Indian pearl oyster *P. fucata* were developed for the first time in India in 1973 (Alagarswami, 1974 a). In the first series of experiments, a rate of 55.8% production was achieved. Subsequently, it has been possible to raise the production rate to 62.8% in single implantations (Alagarswami, 1974 a). Multiple implantation of nuclei has further enhanced the pearl production rate to 180.6% in respect of the number of oysters used (Alagarswami, 1974 c). The possibilities of re-use of oysters for a second crop of pearls have also been indicated.

It has been stated earlier that the inshore waters have a good potential for production of species such as *P. chemnitzii*, *P. sugillata* and other flat oysters in large quantities. It was found that although they produce pearls, they are not of good quality in terms of lustre (CMFRI, 1979). Using the mantle grafts of *P. fucata* on these species it has been possible to improve the quality slightly but the pearls are still inferior to those produced by *P. fucata*. Some of the factors which are responsible for the poor production rate and quality in these species are that they have a thick byssal mass which hinders insertion of nuclei; the epithelium of the gonad is very thin and hence the tear of tissue is greater; the concavity of the left valve is very shallow and therefore the oysters cannot take in large nuclei; and the lustre of the nacre of the shell itself is watery and not bright. It has to be noted that these species are not used in any part of the world for pearl production.

Preliminary data have been obtained on the growth of cultured pearls in *P. fucata* in the Indian waters. The nacreous deposit on the radius of the pearls has been found to be 0.22 mm, 0.26 mm and 0.32 mm on a 3 mm diameter nucleus in 94-108, 161 and 191 days respectively. On the 4 mm diameter nucleus,

the deposition of nacre was 0.31 mm in 161 days. On the 5.81 mm diameter nucleus, the growth was 0.26 mm in 159 days (Alagarswami, 1975). Against the 0.3 mm average annual increase in diameter reported by Cahn (1949) for the growth of cultured pearls in the Japanese waters, the rate of growth of nacre has been found to be much faster in the Indian waters. This enables considerable reduction in the post-operative culture duration.

The Japanese pearl culturists use methods of physical exhaustion through under nourishment and forced ovulation or egg extraction to condition *P. fucata* for the surgery, taking advantage of the thermal stratification of the bays (Alagarswami, 1970; Wada, 1973). In the inshore waters of 5-8 m depth where the pearl oyster farm has been located at Tuticorin the above methods cannot be applied. Menthol has been found to be an efficient chemical for narcotising the oysters for surgery. Experiments have been carried out on the economic use of menthol and minimum doses required have been ascertained. The recovery of oysters on reimmersion in fresh sea water is fast.

Some success has been achieved in developing techniques for the production of shell-bead nuclei (Velu *et al.*, 1973). Conch (*Xancus pyrum*) shell bits have been processed to round beads of different diameters. These have been successfully used in experimental production of cultured pearls. Surgical tools required for the nucleus insertion in the oyster have been produced indigenously (Alagarswami and Sivarajan, 1975).

Farm management

There is very little choice of sites along the coast of the mainland of India to establish pearl culture farms. Elsewhere in the world, the farms are located in the protected bays surrounded by chains of islands. These bays have deep and calm waters with moderate currents to bring in food and flush the droppings from the farm. Such areas are very rare to come across along the coast of the mainland of India. The coastal areas are rather shallow and are subject to rough sea conditions during the monsoons and are also prone to cyclones. The Gulf of Mannar, to some extent, offers a compromise with regard to availability of oysters and workable farming conditions.

The experimental pearl oyster farm could be maintained round the year at Veppalodai off Tuticorin in the Gulf of Mannar. The group of small islands at the head of the gulf provided some protection to the farm at Krusadai Island. The experimental farms in the harbour basins both at Tuticorin and Vizhinjam are only temporary measures and these areas cannot be considered for any long-range programmes. At present farming is done in depths of 4-8 m at these sites.

Raft culture method was introduced in the mariculture activities of India beginning with the establishment of the pearl oyster farm at Veppalodai. In general, the rafts are made of teak poles, lashed with coir ropes and buoyed up with metal barrels. Unit rafts, measuring about 6 × 5 m, are moored independently at two ends using iron anchors and chains. The rafts are clear off the sea surface by about 50 cm. For holding the pearl oysters, frame nets and baskets made with an iron-rod frame and nylon webbing are used. Protective coats of paints are given to all the iron materials. Rafts made of timber sizes and secured with bolts and nuts have also been used. The rigid rafts have to be sturdy to withstand the rough sea conditions.

Aspects of environment for promoting the growth of the oysters and production of good quality cultured pearls have been given some attention. The data have shown that the shallow waters (depth 4-5 m) off Veppalodai do not promote proper growth of oysters (Chellam, 1978). The probable reasons for this are that the turbidity is very high, the coastal

currents are swift and biofouling and boring is heavy. In spite of these handicaps of the environment the rate of pearl production and quality of cultured pearls have been found to be good at Veppalodai.

Fouling and boring have been found to be the two major factors causing deterioration in the health of oysters at Veppalodai. Barnacles, bryozoans and ascidians are the dominant fouling organisms present almost throughout the year and occurrence of spat of edible oysters and *Avicula* is seasonal. The sponge *Cliona vastifica* and the polychaete *Polydora ciliata* contribute to heavy boring on the shells. Alagarswami and Chellam (1976) dealt with these problems in detail and related mortality of oysters in the farm to the heavy biofouling and boring of shells. Frequent shell cleaning operations to scrape the fouling organisms disturb the metabolism of the oysters and the tender growth shoots on the shell margin are eroded at each operation affecting the growth of the oysters. Experiments on the control of the boring organisms have shown that the polychaete borers can be controlled by immersion of the oysters in fresh water and the boring sponge can be killed by brushing the external surface of the shells with 1% formalin (Velayudhan, 1983).

Pearl oysters maintained in the Tuticorin harbour basin show better growth and higher survival rate. The basin is calm, protected against waves by the breakwaters and oyster cages are suspended at a depth of 6-8 m. The water is relatively clear and fouling and boring of the oysters is less compared to the conditions at Veppalodai. Data on farming of pearl oysters in the harbour basin would indicate the minimum environmental conditions required for successful farming of oysters in the inshore waters.

Farming of pearl oysters at Krusadai Island which was revived by the Department of Fisheries of Tamil Nadu in 1978 is reported to have produced good results with regard to the growth of oysters.

At Sikka on the Gulf of Kutch, pearl oysters have been farmed in a pool in the intertidal area constructed with stone embankments (Pandya, 1974). Oysters have also been maintained in shallow tanks on the shore. *P. fucata* of the Gulf of Kutch is an intertidal population unlike in the Gulf of Mannar and hence it could be successfully farmed in above such areas.

Training in pearl culture

The Central Marine Fisheries Research Institute offers training courses in pearl culture to aid further development in this field (CMFRI, 1977). The programme is conducted at two levels: a long term course (six months) at the managerial level and a short term course (six weeks) at the technician level. The former is a package programme of training to include all aspects of pearl culture and the latter is a specific programme on farm maintenance and oyster surgery only. During the years 1976-1979 one long-term course and two short-term courses have been completed. The courses are open to candidates sponsored by the governments of maritime States and Union Territories and Universities. Nationals from other countries, sponsored by the respective governments are also admitted into the courses.

Pilot project on pearl culture

On the industrial side, the only development so far has been the setting up of a pilot project for the production of cultured pearls at Vizhinjam by the Government of Kerala. The resource base for this project is the spatfall in the Vizhinjam Bay. The Central Marine Fisheries Research Institute has established that good quality cultured pearls could be produced from *P. fucata* occurring in the bay (CMFRI, 1974) which has led to the starting of the pilot project.

Research Thrusts for Future

The above review on the recent advances in pearl culture in India would show that the basic technology for commercial production of cultured pearls has been developed during the last seven years. However, several areas of research remain open for future investigations which are essential for strengthening the technology for improvements in resource availability, farming conditions, and production rate and quality of cultured pearls.

Production of additional resource

In view of the fact that production of pearl oysters in the natural beds is not steady and therefore undependable, the first priority is given to develop suitable technologies for assured supply of oysters. The Japanese pearl culture industry is not dependent on the wild populations of *P. fucata* and almost the entire supply of oysters comes from collection of spat using cedar sprigs as collectors (Alagarswami, 1970). The pearl-shell industry of Sudan was revived through the method of large-scale collection of *P. margaritifera* spat using split bamboo shelves in the Dongonab Bay in the Red Sea (Reed, 1962, 1965). Spat collection has not made any headway for *P. maxima* in the Australian waters and in the adjacent areas and only natural populations of the species support the pearl culture industry.

It has been seen earlier that spat settlement in the inshore waters, including the harbour basins of Tuticorin and Vizhinjam, is of a multi-species character and the component of *P. fucata* is very low. Techniques should be developed for the collection of *P. fucata* spat in the natural beds, particularly in beds such as Devi paar where oyster collections have been good in the recent years. In the Gulf of Kutch, the pearl oyster population is widely scattered on an extensive intertidal zone and spat collection should be attempted in the deeper areas adjacent to the flat. The occurrence of *P. margaritifera* in the Andaman and Nicobar Islands has been mentioned earlier. The oysters have been found to occur in the tidal flats and on the pillars of piers. Attempts will have to be made to find out if the split bamboo shelf method as practised for the species in the Dongonab Bay will prove successful in the Andaman Sea.

Hatchery production of *P. fucata* contributes to a small percentage of oysters used in pearl culture in Japan (Wada, 1975). Hancock (1973) has reported attempts at Port Moresby to develop hatchery techniques for *P. maxima*. Priority is being given at the Central Marine Fisheries Research Institute to develop a hatchery for pearl oyster at Tuticorin. Success has already been achieved in controlled spawning of *P. fucata* in alkaline sea water medium (Alagarswami *et al.*, 1983 a). The larvae have been reared in the laboratory upto the straight-hinge stage (Alagarswami *et al.*, 1983 b). Further development in this direction awaits identification of suitable micro-algae and mass culture of the same for feeding the larvae.

Work on the genetics of pearl oysters is very recent (Wada, 1975 a, b). *P. fucata* occurs in two distinct ecological habitats in the Indian waters, namely the deep beds (15-25 m) in the Gulf of Mannar and the intertidal flats of the Gulf of Kutch. It would be of interest to study the genetic resources of these two populations. The hatchery when it is developed, should attempt genetic improvement of the stocks through a breeding programme using the above two populations.

Improvement in farming technology

The technology of pearl oyster farming has evolved in Japan from the initial scattering of oysters on the sea floor through the pearl-string method to the raft culture of oysters which at present is the standard practice (Alagarswami, 1970). It is still the ideal system for rearing such large numbers of oysters under manageable

conditions in protected bays. Although the raft culture technique has been adopted in India, there is considerable scope for improving upon this system to develop methods with reference to the environmental conditions of each farming area. Flexible rafts made of ropes and floats are extensively used in the Seto Inland Sea of Japan where there is wave action.

Interest of scientists seems to have reverted back to the merits of culturing the oysters on the natural beds themselves. Yamaguchi and Hasuo (1978) have taken up comparative studies on the activity of pearl oysters between suspended and bed culture methods in Japan. A pearl culture farm located in Broome in Australia was to try a deep water technique where pearl oysters would be cultured on equipment anchored to the sea bed (Anon., 1977). If a manageable and economically viable technique could be developed in India for culturing the pearl oysters on the natural beds themselves in the Gulf of Mannar, it would substantially enhance the quality of oysters and the quality of the cultured pearls.

Transplantation of pearl oysters to the island ecosystems of the Andaman and Nicobar Islands and Lakshadweep will have considerable importance for commercial pearl culture operations. These provide conditions resembling closely those of the Japanese and Australian farms. *P. fucata* could be transported from the mainland to these islands. Similarly transplantation of *P. maxima* from the eastern bounds of the Andaman Sea to the Andaman and Nicobar Islands could be taken up. If these become successful, the islands could form one of the important pearl culture centres of the world for pearls from the three major species *P. fucata*, *P. maxima* and *P. margaritifera*.

Improvement in pearl production

Pearl production depends on three aspects, namely the physiological condition of the oyster, the techniques of surgery and the environment. No work has been done on the physiology of the Indian pearl oyster so far. Basically, the biochemical composition of the pearl oyster should be investigated in detail. The physiology of nutrition and reproduction should be studied. This would lead to an understanding of the physiological changes that take place due to insertion of nucleus and manipulating such changes to the advantage of production of quality pearls. The histochemistry of mantle tissue and pearl-sac formation also need detailed studies. Calcium metabolism of the pearl oysters and physiological regulation of secretion and deposition of the different layers of shells should be understood. Relation between the maturity stages of the gonad and pearl-sac formation and also quality and shape of the cultured pearls in relation to site of nucleus implantation should be studied. Nutritional requirements in tank culture of oysters should be evaluated for controlled production of pearls. The Japanese workers have recently taken up studies on tissue culture of the outer epithelial cells of the mantle to be able to produce aragonite pearls of good quality (Wada, 1973; Machii, 1974). Work in this direction will be very important for the future of the pearl culture industry.

Improvements in surgical techniques would also be necessary. Satisfactory pearl production rates have already been obtained in single and multiple implantations. There is still scope for a marginal increase of these rates. A careful analysis is needed to reduce the slipping rate of nuclei from the implanted oysters. Pearls with protuberances, dimples and dirt appear in the collection and these may be due to faulty techniques. Graft tissue plays a critical role in pearl production and a detailed study is needed to understand the changes that take place in the mantle tissue from the time it is excised from the oyster till the pieces are inserted. Detailed studies on the convalescence of seeded oysters and post-operative care would also be required.

Development of pearl culture based on *P. margaritifera* in the Andaman waters would need a strategy different from that for *P. fucata*. The blacklip pearl oyster is capable of producing half-round pearls and rarely round ones. Appropriate techniques of pearl production in this species must be developed.

An aspect of immediate concern to pearl culture in India is the production of shell-beads for use as nuclei. The pig-toe (*Tritogonia*), three-ridge (*Pleurobema*) and washboard (*Megalonais*) shells of the Tennessee River of the United States of America are used in production of nuclei in Japan. It would appear that no fresh water mussels similar to the above are available in the Indian rivers. The shells of *Lamellidens* are too thin to be used for the purpose. Similarly the shells of *Parreysia*, though stouter than those of *Lamellidens*, are not thick enough to render them suitable for producing beads of more than 3 or 4 mm diameter. The black clam *Villorita* has a stout shell but is too small to be economic and it may not give larger than 3 or 4 mm diameter beads. Some experimental work has been done with the marine shells of the conch (*Xancus pyrum*), the turban shell (*Turbo niloticus*) and the giant clam (*Tridacna* spp.), the last two from the Andaman waters. It was found that the conch shell would be a better material than the other two in terms of cost and also specific gravity. The conch shells form the raw material for the shell-bangle industry in India and the wastes alone could be used in the production of shell beads for pearl culture (Velu *et al.*, 1973). More detailed evaluation is required in material selection. The techniques of producing shell-beads developed as a preliminary step by Velu *et al.* (1973) need improvements for large-scale production and refinements for achieving dimensional accuracy and finish.

Some basic studies on the hydrological conditions of the pearl culture farm at Veppalodai have been made. There is need for a more critical investigation on the factors that influence the biology and physiology of the pearl oysters and production of pearls. Matsui (1960) has discussed the aspects of the environment of pearl culture grounds in Japan in relation to pearls. According to him, the growth of oysters is strongly influenced by the chemical substances contained in sea water and plankton and the metal ions might affect the quality of cultured pearls. Studies on the nutritional environment, that is the quality and quantity of food available, are important.

Growth of pearls is very much related to the temperature of the environment (Wada, 1969). It has been seen that in the Gulf of Mannar the rate of deposition of nacre is very high (Alagarswami, 1978). However, faster growth is not always linked with quality of the nacre. Thinner layers of nacre are said to improve the quality of the pearls and, therefore, the Japanese farmers resort to 'make-up' culture in areas which are suitable for producing finer quality of nacre before harvest (Alagarswami, 1970). The hydrogen-ion concentration is also an important factor and a lower pH range of 7.3-7.5 appears to improve the lustre of the pearl. These factors are important in deciding the areas for the final stages of culture and seasons for pearl harvests.

Mortality of oysters has been found to be related to heavy load of fouling in some months (Alagarswami and Chellam, 1976). Oysters heavily infested by these pests produce pearls of poor quality. The environmental study of pearl culture farms should pay attention to this aspect.

Tremendous advances have been made by the Japanese scientists on studies on the composition, structure, colour and growth of cultured pearls (Sawada, 1954; Wada, 1976; Wada and Suga, 1977). Besides using the traditional methods of bleaching and dyeing for colour adjustment, colour changes in pearls

have been effected by radiation of gamma rays and neutron bombardment (Sawada, 1959; Shirai, 1970). It is necessary that basic studies are taken up on some of the above aspects in cultured pearls produced in the Indian waters.

Immediate Prospects for Commercial Production

Although pearl culture technology was developed in India in 1973 and attempts have been made since then to propagate the potential for commercial production of cultured pearls, an industry is to yet a make a start. The only programme which has a commercial touch is the pilot project at Vizhinjam. Several entrepreneurs are aware of the potential and have obtained detailed information from the Central Marine Fisheries Research Institute. As pearl culture is a new venture for the country there is some hesitation in the minds of the people to take up this challenge. Perhaps the government sector should give a lead and encourage development of an industry.

The present state of technology is considered adequate to support a moderate pearl culture industry. The *P. fucata* resource position at this time appears satisfactory in some of the natural pearl oyster beds of the Gulf of Mannar. Rate of production and quality of pearls are close to what is obtained in Japan. The necessary infrastructure for training the manpower for the industry already exists in the country. The shell-beads could be imported from Japan for the present until indigenous production is achieved. The industry could be located in the Gulf of Mannar in view of the proximity of the natural resources and advantages of suitable sites. India has a well-established trade for pearls which depends entirely on imports for use within the country and for re-exports. Advantages of pearl culture over pearl fishing have been well established in many countries. Wada (1973) pointed out that the major factor responsible for the remarkable growth of production is that pearls give the highest profit return of all marine products cultivated in the coastal waters of Japan. India which is poised for taking up major programmes in mariculture should take a step forward in the direction of establishing a pearl culture industry without any further loss of time.

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