Prospects of milkfish sea cage farming

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In the last four years, milkfish aquaculture got a boost with the development of cage and pen farming in marine waters. From a practically unknown technology in the early '90s, milkfish mariculture is now the fastest growing sector in the aquaculture industry. It is being practiced in several provinces such as Pangasinan, La Union, Batangas, Quezon, Cebu, Samar, Negros Oriental, Davao del Norte, Davao del Sur, and Davao Oriental. Production from mariculture systems add at least 25,000 tons annually to the country's food fish supply.

While milkfish mariculture was once limited to well-protected coves and estuaries, it is now possible in semi-exposed sites with all-weather cage culture equipment. This contributed paper highlights some of the author's ongoing experience in developing sea cages, a project undertaken jointly with the (Philippine) Department of Science and Technology - Technology Application and Promotion Institute (DOST-TAPI).

Why farm in semi-exposed sites?

Milkfish farming in semi-exposed sites open a vast untapped coastal area for food production and livelihood. It also offers better water quality and high water exchange rates which allow biomass loads in excess of 40 kg per m^3, at least 10 times the yield of pens and double that of conventional cage culture. There is also little threat from industrial pollution and domestic wastes which are commonly encountered in coves and sheltered coastal waters. In conventional marine cage and fishpen culture, organic matter accumulation is a particular concern due to the relatively limited water movement. Eventually such condition can lead to eutrophication, anaerobic seabed conditions, and growth and disease problems. Organic pollution is not only detrimental to the cultured species but also to the diversity of the marine ecosystem as this can promote proliferation of certain organisms over others.

Sea cages with the proper mooring system[1] can be situated safely in deeper waters away from coral reefs and mangrove areas. It does not require the clearing of trees, vegetation, or corals, or the staking of numerous structures (e.g., bamboo) on the sea bed, practices that are characteristic of pond and/or pen culture. For the same productivity, a sea cage utilizes 1/50th the area of a pen and 1/300th the area of an extensive pond. With space not a premium, farmers in semi-exposed coastal waters can be alloted a bigger area to allow them to move the cages after every crop to minimize localized waste accumulation.

Aside from a higher productivity and being more environment-friendly, sea cages have the key advantage of allowing farms to be situated nearer the markets. This permits harvesting on short notice when prices are high.

Developing a local cage design

Farming in semi-exposed environments require special culture facilities and technologies designed to survive rough sea conditions. The Aquaranch™ Sea Cage System (Figure 1) is the product of the first phase of our project with DOST / TAPI entitled "Modern Sea Cage Farming." It adopts the highly successful circular cage design from Europe and Australia to Philippine conditions. The cage float consists of inner and outer foam-filled circular polyethylene tubes which are held together by strategically placed braces. These braces also support stanchions which in turn supports the handrail. The Aquaranch™ has an effective volume of around 1,200 m^3 and will readily support a biomass load of 25 tons per crop.

Early this year, two cage units were installed near Samal Island in Davao Gulf (Figures 2-3). These were stocked with 10 g milkfish fingerlings at 50 pieces per m^3. As of September 1998, the crop is on its 5th month of culture with milkfish weighing 400 g on the average. The cage was intentionally placed in an area with fairly big waves, strong winds, and strong currents, conditions that are typical in semi-exposed sites. So far, the cages and the stock have weathered well 2-meter high waves and 1-meter per second currents. No damage was noted.

The Phase 2 of the project, which is to start by October, involves the commercial operation of a new modular steel cage design for grouper and other high-value marine species (Figure 4). Compared to existing local steel cages, the improved design using CAD technology is expected to have nearly threefold greater tolerance to wave stresses. The standard module consists of four units of 4 x 4 m cages, which can be converted to two units of 4 x 8 m cage or 1 unit 8 x 8 m cage. The cage can be assembled to a maximum dimension of 12 x 12 m for fairly calm waters.

[1] Mooring systems are featured in AQD's bimonthly **Aqua Farm News** (Vol. XII No. 1). This publication, however, was later merged with *SEAFDEC Asian Aquaculture*. Photocopy of old issues may be requested from the AQD Library. - *Ed.*

Figure 1
Close-up view of Aquaranch™ sea cage

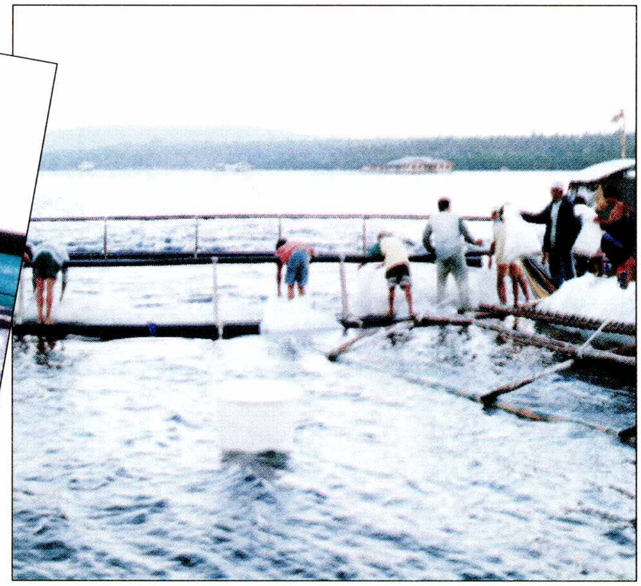

Figure 2
Stocking milkfish fingerlings at 50 fish per m^3.

Figure 3
A solar-powered directional feed spreader simplifies feeding management.

Technical and economic aspects in sea cage farming

Up until recently, milkfish cage farmers as well as pond and pen farmers have enjoyed favorable market prices which has allowed a high margin of safety for inefficiency and errors in operation. This is not the case anymore, and will likely to be so in the years ahead with the aggressive developments in fish culture. As with any food commodity, the key to competitiveness is maximizing yield at the least cost. While cage farming addresses the need to be more productive compared to that of other fish culture systems, many current practices are not at all efficient, resulting to a high production cost. This is especially true for feeds and seedstock. These two inputs account for more than 80% of production expense. Summarized below are some important points that need to be addressed for a profitable sea cage venture.

Feeding management

Milkfish mariculture tends to have a high feed expense and this can be traced to poor feeding management. The current practice of hand feeding limits feed distribution such that foraging of the bigger, more aggressive fish are favored, eventually leading to a large variation in size. A variable population size should be avoided as this reduces feed conversion efficiency -- i.e., bigger fish end up overfeeding and smaller fish underfeeding. This problem aggravates when shifting to the next bigger feed grade. In order to ensure that each fish gets its share of food, it is important to spread feed rations as wide and uniform as possible on the cage surface. This practice also minimizes feeding frenzy which contributes to feed losses from the increased water currents generated during feeding.

Unlike in pens and ponds where there is a bottom substrate, feeds in cages (i.e., sinking diets) fall through the net. Water currents can also easily carry feeds out through the side of the cage. To reduce feed wastage, the feed rations have to be given in controlled amounts for extended periods. Feeding four times at 30 minutes per ration should be the minimum.

Experience shows that the above demands in feeding management cannot be effectively done by hand. This is especially so during very hot days, when it is raining, or when sea conditions are choppy. In order to optimize feed conversion in sea cages, mechanized feed spreaders would have to be utilized. A solar powered automatic feeder was thus developed as an integral component of the Aquaranch™ cages. The ongoing crop suggests that feed conversion with the use of this feeder can be improved by at least 10%.

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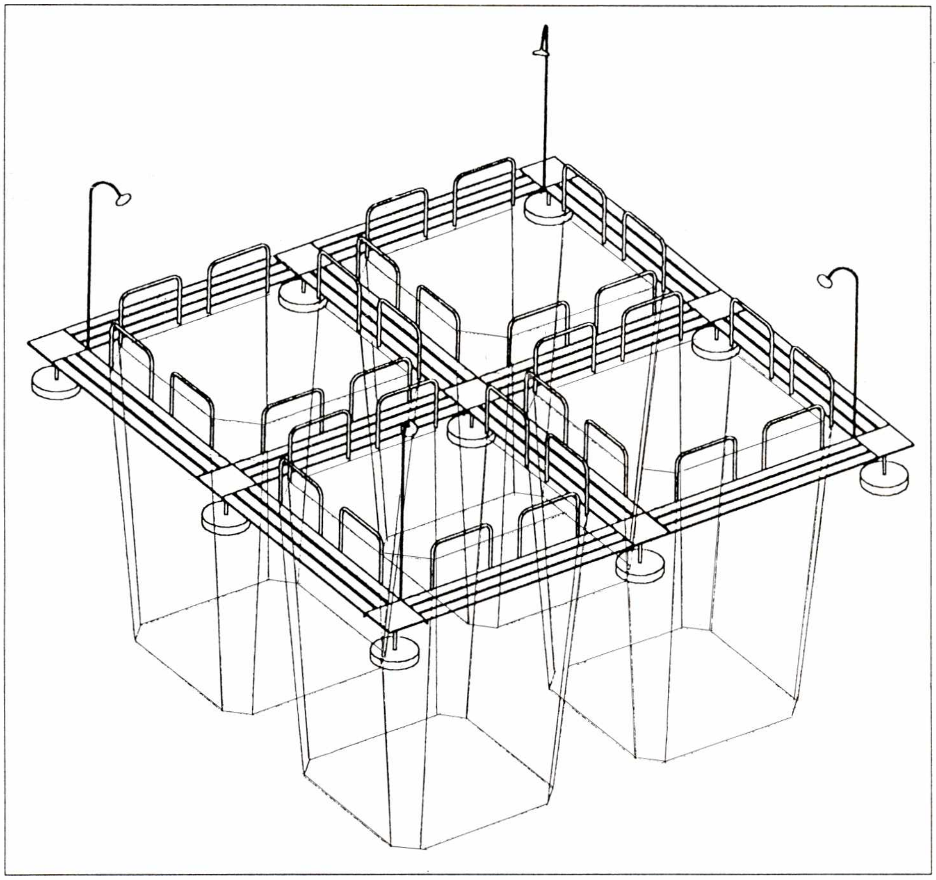
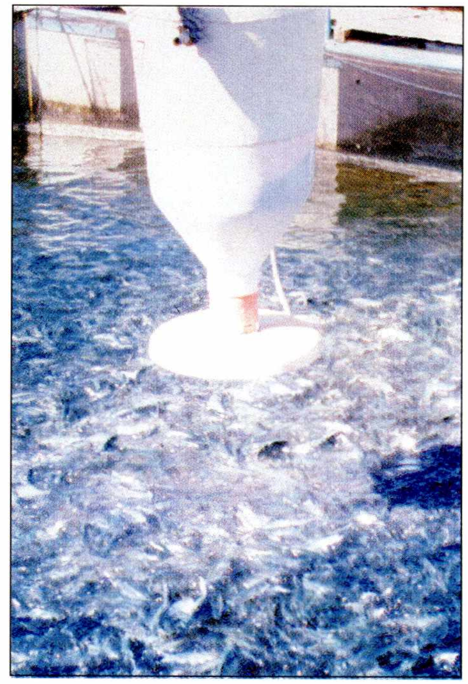


Figure 4 Prototype of modular steel cage; 8 x 8 m module can be divided into four 4 x 4 m cages

Figure 5 Experimental feeder for modular cage



Seedstock

After feed, the next most significant cost in cage farming is the fingerlings. Commercial fingerlings cost between P2.5-3.5 per piece, and depending on the survival, this represents around 15-20% of production cost. Operating one's own nursery will lead to savings of at least P1 per fingerling or around P3 per kg in production expense. It also allows production of the desired size of fingerling at the desired time. In the long run, farmers who operate their own nursery will have an edge. It is important to note that semi-exposed sites at one time or another will be exposed to strong waves and currents. While the big fish readily take this with minimal stress, small fish do not. A fingerling size of at least 15 grams is thus recommended for stocking in semi-exposed cage farms.

Feed quality

In ponds, the natural food factor which can mask nutritional deficiencies in the feed often makes comparisons in diet quality inconclusive such that price becomes a sound basis of choosing a feed. In the sea cage environment, however, the sparse natural food supply demands a well formulated diet. It is thus important to be conscious of feed quality and not just the price.

The average feed conversion ratio (FCR) presently being obtained in milkfish mariculture is between 2.2-2.4, with "good" FCRs at around 2.0. In salmon culture, years of research and experience have allowed feed conversion to be improved, from 2.0-2.2 to presently around 1:0. Clearly, there is still a lot of room for improvement with milkfish diets.

To obtain efficient feed conversions, the direction of the industry should be towards extrusion processing with the use of energy-dense nutritionally balanced formulations and higher quality raw materials. The challenge for feedmillers is to improve feed conversion without significantly increasing feed cost. Feed expense at present accounts for P30-35 per kilogram of fish produced or 65-75% of production cost. If feed conversion can be improved from 2.2 to even only 1.8, production cost effectively drops already by P 5-6 per kg.

Fines (or powder feeds) contribute substantially to a lower feed conversion hence should by all means be avoided. Unlike in ponds where these can re-enter the food web as a fertilizer or microbial substrate, fines end up as wasted feed outside the cage. Poorly pelleted feeds contain as high as 4-5% fines. Thus, waste from fines alone already accounts for some P1 of the production cost. Extruded feeds normally have much lower fines at around 1%.

With feed use and seedstock properly addressed, production cost in milkfish cage culture can be reduced to P34-38 per kg from the current average of P40-45 per kg. Compared to high density pond culture,

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number of stock, that is, for every 1,000 pcs of at least 250 g milkfish, 1 bag of feed is dispensed. It is believed that the more feeds they give, the faster the growth. Most feeders or caretakers do not feed properly. Some of them pour the feeds into the pen or cage and do not consider whether or not these are consumed. This poor feeding practice usually results to a feed conversion ratio (FCR) of 3.0 to 4.0.

Some growers try to follow the feeding management techniques taught by some feed suppliers. One of the original fishpen operators, Ms. Cresing Quebada, developed an efficient management strategy (feeding continuously, making sure that all milkfish were fed) which helped her lower her production cost with improved FCR of 2.2. This reduction on feed cost enabled Ms. Quebada to profit even as milkfish price goes as low as P55.00 per kilo for 500 g size.

At present, some operators use automatic feeders in their pens and cages. A bigger feeding area is covered with the use of the feeder as compared to hand feeding. This method allows more milkfish to feed at the same time. Most operators who tried this feeder had improved FCR of 1.8 to 2.0. Another advantage is that the stock can be fed continuously even during bad weather.

Problems

Most of the pens and cages are overstocked, thus large amounts of feeds are added to these pens and cages everyday. At the peak of operation (1997), when estimated monthly production from Pangasinan is 3,000 tons, 9,000-12,000 tons of feeds per month are used in the area. These pens and cages now exceed the carrying capacity of the farm sites, particularly in terms of dissolved oxygen supply. Several fishkills have been experienced in Binamley and Anda area since 1995. The largest fishkill was in April and May 1997, with P70 million losses. Because of the environmental problems brought by the operation, almost all fishpens and fishcages in the Binmaley, Anda and adjoining areas in

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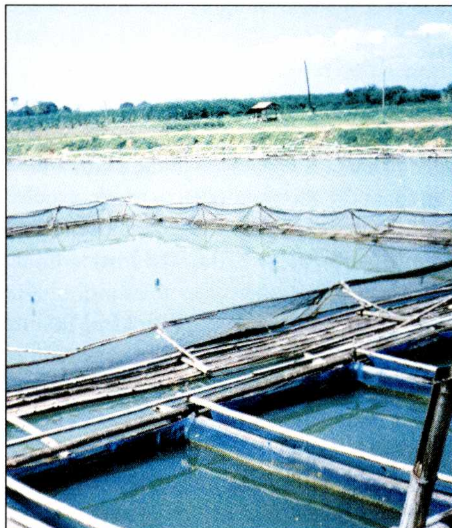
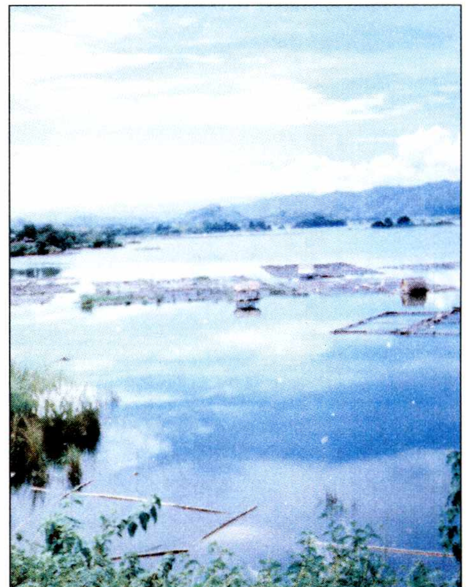
SEEN & NOTED

TILAPIA CAGE CULTURE IN THE PHILIPPINES

PHOTOS BY A DE LA VEGA





CLOCKWISE *Tilapia cages in a 7 ha man-made lagoon in Himamaylan, Negros Occidental; tilapia cages in Magat Dam, Isabela; and tilapia cages in Lake Sebu.*

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production cost in sea cages is actually lower. Aside from having a considerably higher productivity at a lower capital cost (at least thrice more fish biomass for about the same investment in facilities), farming milkfish in the sea does not require pumping and aeration, an expense that adds 8-10% on production cost in intensive ponds. With the right technology, sea cage farming of milkfish offers a competitive edge in aquaculture.

A promising future

Sea cage farming in semi-exposed waters satisfies a growing national thrust for a sustainable and environmentally friendly approach to maximizing foodfish production. With so much coastal area available, there is little doubt that this new production technology can help ensure the supply of low cost and high quality protein for the country's burgeoning population. The recent currency devaluation and drop in milkfish prices, on the positive side, opens up doors for developing a competitive export industry that can generate much needed foreign exchange and even generate livelihood for marginal fisherfolks increasingly being displaced by the dwindling sea catch. #