

An Improved Strategy for Building Brackishwater Culture Ponds with Iron Pyrite Soils in Mangrove Swamps

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The problems associated with acid sulfate soil limit the potential utilization of vast coastal areas of mangrove swamps for brackishwater aquaculture. There is an estimated 4.8 million ha of mangrove area in the ASEAN countries alone. Until recently, most attempts to build earthen ponds in these areas have yielded poor results.

Aquatic Farms, as technical consultants for a 250 ha-prawn farm in Johore Peninsula, Malaysia, developed a construction technique that utilized the volcano-like burrow mounds of the mud lobster (*Thalassina anomala*) to cover and seal pond embankments that has minimized the culture problems usually experienced with iron pyrite soil. The strategy, pond design and construction technique are described. Pond dynamics and performance are discussed since the commencement of culture operations and these are compared with a nearby prawn farm that was constructed using conventional techniques. A cost benefit analysis is given in conclusion.

Penaeid Larval Culture Using Microencapsulated Diets

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Whilst it has been possible for many years to feed postlarval penaeids successfully on artificial diets, problems of nutrient leaching, particle breakdown, and water fouling have prevented the use of such diets for early planktonic larval stages. It has recently been demonstrated that the technique of microencapsulation may be used to overcome these problems. Live foods used for penaeid culture have been successfully replaced by microencapsulated diets, both in the laboratory and at the hatchery level. The technology has now reached the level at which dietary requirements of individual species can be met by the incorporation of specific nutrients. Capsules can be supplied to function either as complete nutrient delivery systems or as food supplements.

The present paper reviews this progress towards the total replacement of live foods in penaeid culture, and assesses the results of recent culture trials.

The Use of Microencapsulated Feeds to Replace Live Food Organisms in Shrimp Hatcheries

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An adequate supply of hatchery produced shrimp fry is the major constraint to the intensification and growth of shrimp culture practices. If even 20% of the more than 500,000 ha of the world's existing tropical and sub-tropical brackishwater ponds were to stock at the relatively low density of 50,000 fry/ha/year, it would take thousands of new hatcheries to produce the 25 billion fry required. The availability of artificially produced diets to replace cultured live food organisms would alleviate many of the problems currently limiting shrimp hatchery production by: (i) reducing the level of technical skill required to operate a hatchery; (ii) assuring a reliable supply of a nutritionally balanced larval feed; (iii) reducing sources of contamination and larval disease; and (iv) simplifying hatchery design and capital cost requirements, thereby facilitating small scale hatchery development.

Aquatic farms has been working with the Mars Microencapsulation Research Group (MMRG) to develop techniques for adapting current shrimp hatchery technology and design so that MMRG feeds can be used in existing hatcheries as a live feed replacement. Feeding trials have been conducted in commercial hatcheries in Hawaii, Malaysia and Thailand. The results of these trials and the techniques employed are discussed. Growth and survival of larvae fed microencapsulated diets as total or partial replacement of live foods was comparable to larvae cultured in control tanks using the standard operating procedures of the hatchery in which the trials were conducted. In trials to date, larval survival from nauplii to postlarvae has been as high as 70%.

The Response of *Penaeus monodon* Juveniles to Varying Protein/Energy Ratios in Test Diets

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The response of *Penaeus monodon* juveniles (0.71±0.11 g) to varying protein/energy ratios in test diets was determined. Purified diets consisting of different levels of protein, lipid and carbohydrates were formulated. Two sets of experiments were conducted with the following diet combinations: (1) 30, 30, 50% protein, 5, 10, 15% lipid and 0, 10, 20%

carbohydrate and (2) 40, 45, 50% protein, 5% lipid and 20, 25, 30% carbohydrate. Protein and energy ratios ranged from 89-198 mg protein/Kcal while the energy values for all diets were 165-415 Kcal/100 g. The diets were given twice daily at 10% of the body weight.

Results showed that a two- to three-fold increase was observed in the body weight of prawns fed with diet combinations of 40-50% protein, 5-10% lipid and 20% carbohydrate with energy values of 285-370 Kcal/100 g. Reduction in protein content of the diet from 50 to 40% while maintaining the total energy level (285 Kcal/100 g) resulted in a change in growth that was not significant. An increase in energy level, at constant dietary protein level, resulted in improved utilization of protein and feed conversion efficiency.

Effect of Various Levels of Squid Protein on Growth and Some Biochemical Parameters of *Penaeus japonicus* Juveniles

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An unknown growth factor previously suspected in squid meal was found in the protein fraction of squid (*Loligo vulgaris*). It is clearly different from hydro-alcohol-soluble feed attractants that are also present in squid meal. This squid protein fraction (SPF) improves the growth of *Penaeus japonicus* juveniles when added either in a semi-purified or in a more complex mixed diet. This growth-promoting effect does not seem to be related to the amino acid composition of SPF. In order to obtain more information on its action, several levels (1.5 to 16.0%) of SPF were added to a mixed diet. The diets were isoproteic (59% D.M.), isolipidic (8.5% D.M.), supplemented with vitamins, cholesterol, glucosamine, etc. They were fed as wet pellets to 3 replicates of 15 shrimp; blue mussel was used as the control. The growth of shrimp increased with the SPF level and attained a plateau above 6%. Body weight was significantly higher than that of the control group at this level. RNA content and RNA:DNA ratio increased with the SPF level indicating that growth was improved more by hypertrophy than by hyperplasy of the cells.

The hepatosomatic ratio remained unchanged. The assay of two digestive enzymes, proteases and amylases, showed no clear effect of SPF on protease or amylase activities. More experiments are needed to explain the effect of the unknown growth factor of SPF.

Imperatives for the Future Development of Prawn Culture in the Cochin Backwater System (Kerala, India)

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A traditional system of prawn culture practised in the Cochin Backwater System, the largest backwater system in Kerala State, has an estimated yield of 4,000 tons from about 4,500 ha. Governmental investments to encourage prawn production on a scientific basis continue to grow with the dual objective of improving the socio-economic conditions of fisherfolks and augmenting prawn exports. A geographic study of land and water uses and an assessment of environmental impact of these uses point to basic incompatibilities of city expansion and semi-intensive prawn culture. Population growth, urban expansion and industrial development projections for Cochin City and its surrounding areas support the view that water quality will deteriorate further making culture of prawns for export a difficult proposition. Functioning horizontal-communications between city and fisheries planning units are essential as are improvements in environmental protection than presently evident. Attention is directed towards examining other options for improving socio-economic conditions of fisherfolks and increasing prawn production and developing public policy for protecting prawn culture areas elsewhere.

The Economics of Different Prawn and Shrimp Pond Culture Systems: A Comparative Analysis

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The paper aims to present a comparative economic evaluation of different pond culture systems for prawn (*Penaeus monodon*) and shrimp (*P. indicus* and *P. merguensis*) using standard economic tools and methods of analysis. The different culture systems include extensive and semi-intensive monoculture of prawns and shrimps and the extensive polyculture of these species with milkfish (*Chanos chanos*). Data used in the analysis were taken from both SEAFDEC AQD and industry experience. The technical data were gathered from researchers and private sector experiences in prawn and shrimp farming. Financial estimates were determined after the peculiarities of aquaculture *vis-a-vis* other business ventures in agriculture and industry were taken into consideration.