PROCEEDINGS OF THE SYMPOSIUM ON COASTAL AQUACULTURE

Held at Cochin

From January 12 to 18, 1980

PART 4: CULTURE OF OTHER ORGANISMS, ENVIRONMENTAL STUDIES, TRAINING, EXTENSION AND LEGAL ASPECTS

(Issued in December 1986)

MARINE BIOLOGICAL ASSOCIATION OF INDIA

POST BOX NO. 1023, COCHIN-682 031, INDIA

Price : Rs. 400.00

SYMPOSIUM SERIES 6

Abbreviation

Proc. Symp. Coastal Aquaculture, Pt. 4.

PRINTED IN INDIA BY A. D. THOMAS STEPHEN AT THE DIOCESAN PRESS, MADRAS 7 AND PUBLISHED BY E. G. SILAS ON BEHALF OF THE MARINE BIOLOGICAL ASSOCIATION OF INDIA, COCHIN-682 031

Proc. Symp. Coastal Aquaculture, 1986, 4 : 1450-1455

FIN-FISH CULTURE *

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INTRODUCTION

THE TOTAL yield from wild stocks of marine species is still increasing but at a progressively reduced rate. With the declaration of the Exclusive Economic zones and consequent realignment of marine fishing activities all over the world, a greater awareness has been created for production of aquatic food, particularly animal protein food.

Aquaculture is an age old practice in some countries but in others, it is of a very recent origin. It has developed from small-scale fish farming to large aquaculture industries. The evolution of modern aquaculture involves improvements to environment, large scale fish farming and sophisticated systems of intensive culture for various organisms.

World production through aquaculture in 1975 was estimated to be over 6 million tons and has been projected to be 12 million tons by 1985. In 1977, the provisional figures indicated a total production of 7 million tons, of which about 3 million tons are derived from mariculture. Within the production through mariculture, the share of marine fin-fish was about one million tons. While the cost of fishing, the law of the sea and the need to find employment for excess fishermen provided the necessary incentives for aquaculture development, the high costs of feeds, shortage of fertilizers, pollution problems and indiscriminate application of certain environmental protection regulations reduced the pace of aquaculture development.

The present area under aquaculture is estimated to be 3 to 4 million hectares with a production of few kilograms to about 20 tons per hectare per annum. It is expected that there could be a ten-told increase in the area and 2 to 3 fold increase in yield within a short time, provided necessary investments are forthcoming. The present day fish farming has expanded in area, methods and technology.

MAJOR GROUPS/SPECIES

Fish are raised in freshwaters (warm and cold), brackishwaters and in the sea. The species include the catadromous, anadromus and other marine species which spend their entire life-cycle in salt water. Purely marine species are also raised in brackishwater and purely fresh water species in low saline waters. Although some impressive culture of a few species of fishes has been established, the scope has been limited with emphasis only on 'luxury' items. Aquaculture is in its infancy, despite tremendous research efforts and investments in recent years.

The following are the major groups/species of fishes being cultured in several parts of the world along with rates of production.

I. Mullets

i. *Isreal* (Commercial) : 512 kg/ha/109 days-Polyculture with *Tilapia*.

* Keynote address delivered at the Symposium.

ii. *Italy* (Commercial) 200 kg/ha/year—Valli culture with gilthead bream and bass.

iii. *Hong Kong* (intensive, with supplementary feeding) : 2,500-3,500 kg/ha/growing season (?).

iv. *India* (Commercial)

(*a*) *Bheris* (W. Bengal) : 111.4-168.2 kg/ha of mullets and prawns.

(*b*) Paddy fields (W. Bengal) : 62% of production is mullets. India (experimental, Cochin farm, early forties) : 4,090-4, 771.8 kg/ha/2 years (?) : Production rates about 1000 nos. of fish/ha/ ?

v. *Philippines* (Commercial) : 336 kg/ha/year—Polyculture.

vi. *U.A.R.* (experimental) : 350 kg/ha/year-polyculture.

II. *Chanos chanos*

i. *Indonesia* (Commercial).

a. Traditional method : 50-500 ka/ha.

b. 3 months rotation method : 5,000 kg/ha

ii. *Philippines i*

a. Traditional ponds : 67 kg/ha

b. Lake pens : 4 tonnes/year.

iii. Taiwan : 2,000 kg/ha/year—estuarine ponds, pens

v. *India* (experimental) :

a. Sandy, low productive substratum : 457 kg/ha/year (Mandapam)

b. Clayey locality : 857 kg/ha/year (Tuticorin).

III. Eels

i. *Japan*

a. Still waters : 6, 120 kg/ha/year

b. Running water : 25,360 kg/ha/year

ii. *France*

10-12 tonnes/ha.

iii. *Italy*

3 kg m^3/year

iv. Yellow tail

Japan i 20-25 tonnes/ha/year.

V. *Chrysophrys*

Japan i 6 tonnes/ha/year.

Culture Systems

The culture systems include the very extensive pond cultures of milkfish, shrimp in the trap systems, tilapia in brackishwater and freshwater, the milkfish and seabream in freshwater ponds and cage culture of fish in enclosures at sea. The culture systems have expanded from simple ponds to running water systems or raceways and enclosure systems ranging from rafts and cages (floating and sugmerbed) to framing fjords. The systems include culture of forage and predator fish. They may be extensive or intensive cultures.

Source of Seed

The seed for culture purposes is collected from natural sources and controlled breeding is still in the experimental state. Production of fish per unit water area can be increased by the fuller utilization of spawn from the sea, development of efficient gear for capture of fry, detection of new fry grounds, improved techniques of growing seed in brackishwater farms, better methods of preparation of ponds, use of organic and inorganic fertilizers, stock manipulation, use of supplementary feed and use of pesticides.

For some species, eggs, fry and fingerlings can be obtained only from the sea. There may be considerable variations in the availability of the seed. In other cases, it is possible to

raise and spawn adult fish. The modern practice of injecting hormones is used to obtain spawning and another method is to adjust photoperiod.

Artificial Feeds

A great variety of artificial feeds have been developed for maintaining fish in different systems and for increasing production. However, the very high cost of preparation, the conversion ratios, mortalities etc. have lead to production of only 'luxury' class fish in many cases. Improvements in this field are limited by the ability to secure various feed ingredients, mainly the fish meal, and their rising costs.

Sea Ranching

Referred to by a variety of names in different countries, sea ranching is the process of releasing hatchery reared animals into the sea for rearing and subsequent recapture of the adults upon their return to the point of release. Political and public decisions may restrict future development of this method.

Recent Advances

Important development in aquaculture in recent years include cage and enclosure/pen culture, polyculture, tilapia culture, shrimp and prawn farming, eel and oyster culture, recycling of water including utilization of waste heat. Special attention has been paid to controlled reproduction and formulation of artificial feeds. Hypophysation, manipulation of environmental parameters, use of prepared mammalian hormones in breeding procedures are major developments in the field. Other achievements include development of techniques of preservation of fish sperm, maintaining captive brood stock, find reliable sources of fish seed and acceleration of selective breeding. However, further studies are needed in the areas of standardization of dosage of hormones, precise methods of determining the state of maturity of the recipient fish and nutritional requirements in reproduction.

Since all energy is diverted to the maturation of gonads, the age at which the fish matures is a crucial factor in arresting growth. If maturity can be delayed or late maturing and sterile species can be bred, this may contribute to increase in production. Efforts have been made to manipulate chromosomes to produce sterile fish. Experiments are being conducted to prevent sexual maturity with the aid of hormones.

Intensive fish culture involves prevention of disease. Vaccination, use of antioxidants to prevent dietary diseases and application of antibiotics for control of bacterial diseases are some of the methods in vogue.

Techniques for rearing eggs and larvae of some species of marine fishes have been developed but commercial production of such species is yet to be achieved. Cross breeding of pelagic and demersal species may be a method to obtain economic yields from such fish.

Lacunae

It is often debated why it has been possible to culture fresh-water species extensively but not the marine species. Many economic reasons are suggested. The basic problem has been the mastery of the reproductive cycle of the species concerned. Unless there is mass production of fry of marine species, very little progress can be expected in mariculture. This is a challenge requiring great effort, imagination and investment.

Although fish farming has gained momentum, compilation of statistical data has been inadequate. Lack of skilled personnel, unwillingness or inability of producers to provide

information, scattered location of production units, lack of interest to finance collection of data by some countries have all contributed to this scarcity.

COUNTRIES

Countrywise production rates of fin-fish are given below :

1. Mainland China : Of about 22 lakh tonnes of aquaculture production, about 2 lakh tonnes are believed to be from marine fin-fish culture. Believed to be mostly mullets, *Chanos* and eels, in estuarine and coastal ponds : mostly extensive.

2. U.S.S.R. : Of about 2.1 lakh tonnes of aquaculture production, about 1 lakh tonnes are believed to be from marine fin-fish culture. Believed to be mostly mullets and eels, in estuarine and coastal ponds ; mostly extensive cultivations.

3. Japan : Total mariculture fin-fish production—1.5 lakh tonnes annually.

   i. Yellow-tail (*Seriola quinqueradiata*) 81,000 tonnes annually ; coastal ponds, net enclosures, floating net cages ; intensive culture, rotation method ; artificial feeding.

   ii. Eels (*Anguilla japonica*), 25,000 tonnes annually ; inland ponds ; intensive culture ; artificial feeding.

   iii. Porgy (*Chrysophrys*), 1,000 tonnes annually ; net enclosures and floating net cages ; intensive culture ; artificial feeding.

   iv. Filefish (*Monacanthus*), 100 tonnes annually ; net enclosures and floating net cages ; intensive culture ; artificial feeding.

   v. Puffer (Fugu), 150 tonnes annually ; net enclosures and floating net cages ; intensive culture and artificial propogation ; artificial feeding.

   vi. *Caranx*, 70 tonnes annually ; net enclosures and floating net cages ; artificial feeding.

4. *Indonesia :* Total mariculture fin-fish production—1.5 lakh tonnes annually.

   i. Milkfish (*Chanos chanos*), 90,000 tonnes annually ; estuarine ponds ; extensive culture.

   ii. Mullets (*Mugil cephalus* etc.) 30,000 tonnes annually ; estuarine ponds ; extensive culture.

   iii. *Tilapia*, 10,000 to 20,000 tonnes annually ; estuarine ponds, extensive culture.

5. *Philippines :* Total mariculture fin-fish production—1.2 lakh tonnes annually.

   i. *Chanos chanos*, 1,00,000 tonnes, annually ; estuarine ponds, pens, net enclosures; extensive and intensive operations.

   ii. Mullets (*Mugil cephalus* etc.) 20,000 tonnes annually ; estuarine ponds, pens, net enclosures ; extensive and intensive.

6. *Thailand :* Total mariculture fin-fish production—50,000 tonnes annually.

   i. *Chanos chanos*, 30,000 tonnes ; estuarine ponds, pens, net enclosures ; extensive.

   ii. Mullets, 15,000 tonnes ; estuarine ponds, pens, etc. ; extensive.

7. *India :* Of the total aquaculture production of about 5 lakh tonnes, about 50,000 tonnes is estimated to be from mariculture fin-fish source ; about 25,000-30,000 tonnes are estimated to be from mullets (*Mugil cephalus, Liza macrolepis, L. dussumeri, Rhinomugil*

corsula. L. tade, etc.); 10,000-15,000 tonnes from *C. chanos*; 5,000-10,000 tonnes from *Lates calcarifer*.

8. U.S.A.—Total mariculture fin-fish production about 10,000 tonnes.
   i. Pompano (*Trachinotus*), 3,000 tonnes; coastal ponds and floating net cages; artificial feeding.
   ii. Salmonids (*Salmo*, *Oncorhynchus*), 5,000 tonnes; net enclosures and net cages; artificial feeding.
   iii. Mullets, 2,000 tonnes; coastal ponds; net enclosures; extensive.

9. *Italy*: Total mariculture fin-fish production about 10,000 tonnes.
   i. Mullets (*Mugil cephalus* etc.) 7,000 tonnes; estuarine ponds; extensive.
   ii. Eel (*Anguilla*), 3,000 tonnes; estuarine ponds; extensive.

10. *Israel*: Total production about 10,000 tonnes; mostly mullets; coastal ponds; intensive cultivation.

11. *Malaysia*: Total production about 7,000 tonnes; Chanos and mullets, estuarine ponds and pens; extensive culture.

12. *France*: Total production about 7,000 tonnes; mostly mullets and eel; estuarine ponds and net enclosures; extensive.

13. *Denmark*: Total production about7,000 tonnes; mostly salmonids (*Salmo*); floating net cages and fjords; intensive; artificial feeding.

14. *Norway*: Total production about 2,000 tonnes; salmonids (*Salmo*); floating net cages and fjords; intensive; artificial feeding.

15. *U.K.*: Total production about 2,000 tonnes; mostly flat-fishes (*solea*, *Pleuronectes*, *Scophthalmus*); lochs, net cages; heated waters; Intensive culture; Artificial feeding.

Trends in Production

In 1970, the total fish production through aquaculture was 2.6 million m.t. In 1975, it was nearly 6 million m.t. of which fin-fish contribution was estimated to be about 4 million m.t. The catch may be doubled by 1985 through application of modern technology which involves more efficient use of each unit of water area through greater concentration of number of fish, polyculture, more area brought under culture, feeding efficiency and breeding. For increasing production, greater amounts of fish meal have to be diverted for manufacture of artificial feeds. This involves better fish feed conversion. Increase in volume of cultured fish is related to production of forage fish relying on natural foods. All this means use of more water areas in those parts of world where fish culture is not commonly practiced to-day. African, Central and South American countries should intensify production.

Increase in production is dependent on marketing, price structure, political and legal considerations. Long term rights over water areas would benefit fish farmers. The rate of development and volume of production depends on the type and amount of assistance from Governments. Aquaculture would be affected by the ability to finance development, repayment provisions, infrastructure facilities including research, extension service, etc.

Economics

Since most of the coastal aquaculture operations are done on family basis appropriate records are not available on cost and earnings. However, they are known to be profitable.

Developing countries have somewhat been over enthusiastic by adopting highly sophisticated technology involving high cost and high degree of technology for achieving high production. These methods are suitable for rich countries where the earning and purchasing power of the people are high. Where large areas of land are available, labour is cheap and financial resources are poor. In such areas, less expensive techniques involving low cost should be tried though the production may be low.

FUTURE

The present production from aquaculture mainly comes from fresh or brackishwater ponds. It appears that large scale production of protein food in future must come from culture of marine species in the sea or in coastal waters. Competitive fish farming requires a definite frame work which includes fry production, feed supply, professional know-how, disease control, proper marketing etc. Thus, fish farming should become an integrated industry. Modern fish farming is inclined towards vertical integration. The farms are expected to be larger than at present.

Large scale fish farming requires an infrastructure comprised of systems for marketing, communication and supportive professional research. It needs financial backing of the government, Aquaculture is hard met to compete with industry. In order to encourage investment in the fish industry, Government must have a clear cut policy for aquaculture in general and fish culture in particular. The capital invested in fish farming must be subsidised by low interest rates, outright grants or by providing basic site needs like roads, water supply, electricity etc. Fish culture should be viewed as a means of developing a country's natural resources. The concept of integrated commercial aquaculture may be the main theme of future aquaculture development for becoming a contributing factor in fish production.