

APPLICATION OF COSTING TECHNIQUES TO AQUARICULTURE

*THESIS SUBMITTED IN PART FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF FISHERIES SCIENCE IN FISHERIES ECONOMICS TO THE
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CERTIFICATE

This is to certify that the thesis entitled, “**APPLICATION OF COSTING TECHNIQUES TO AQUARICULTURE**” submitted in part fulfilment of the requirements for the award of the degree of **MASTER OF FISHERIES SCIENCE** in **Fisheries Economics** to the Tamil Nadu Veterinary and Animal Sciences University, Chennai is a record of bonafide research work carried out by Selvi. T. UMAMAHESWARI under my supervision and guidance and that no part of this thesis has been submitted for the award of any other degree, diploma, fellowship or similar titles and that the work has not been published in part or full in any scientific, popular journal or magazine.

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ABSTRACT

Title : **Application of Costing Techniques to Aquariculture**
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The study was taken up to analyse the economics of aquariculture (ornamental fish culture) by applying alternative costing techniques such as cost-plus method in Thoothukkudi and Madurai districts during the period 2002-2003. The specific objectives of the study were to estimate the unit cost of production, to price the selected ornamental fishes by cost-plus method, to compare the estimated prices with the actual selling prices, to estimate a cost function on total cost and variable cost bases, to identify the marketing channels and constraints to aquariculture and to offer policy suggestions for aquariculture development in the regions. The required data were collected from over 95 % of the farmers and 85 % of the retailers in both the districts by administering a structured interview schedule to the respondents.

Thoothukkudi district

The total farm area (4.14 ha) was classified into institutionally based and non-institutionally based units. The estimated total cost was Rs. 30,75,820, constituting a total fixed cost of Rs. 10,24,112 and total variable cost of Rs. 20,51,708. Farmers realized a total returns and net returns of Rs. 41,63,900 and Rs. 10,88,081 respectively. The cost benefit ratios were 1.35 and 2.03 on total cost and total variable cost bases respectively. Apportioned total cost was used for computing mark-up and net returns in ornamental fish production and business. Cost function was estimated on total cost basis, where apportioned total cost was considered as a function of production (Y). Temperature fluctuation during peak summer and winter periods and environmental factors in adverse conditions, mortality and disease outbreak, pilfering and social problems and absence of adequate knowledge on aquaculture were the major resource, production, management and extension constraints respectively.

Madurai district

In Madurai district, the selected farms were classified into leased-in (0.37 ha) and non-leased in (7.395 ha) farm units. The estimated total variable cost was Rs. 68,42,934 and the total fixed cost was Rs. 18,78,496 constituting total cost of Rs. 87,21,430. The estimated total returns and net returns were Rs. 1,11,02,500 and Rs. 23,81,070 respectively. The cost benefit ratios on total cost and total variable cost bases were 1.27 and 1.62 respectively. Apportioned total cost and total variable cost were used for computing mark-up and net returns for ornamental fishes produced in Madurai district. Cost function was estimated on both total cost and total variable cost bases. Collection of live feed in distant areas, mortality and disease outbreak, non-accessibility to farms, location of shops in

interior areas and prevailing tough competition and absence of adequate knowledge on aquaculture were the major resource, production, management and extension constraints respectively.

The different marketing channels followed by fish farmers were investigated in both the districts. It has been found that Channel I (Producer/Wholesaler → Retailer → Consumer and Producer/Retailer → Consumer) was widely followed by medium farmers of both Thoothukkudi (33 %) and Madurai (27 %) districts.

Chapter 1

INTRODUCTION

Fisheries development plays an important role in the economic growth of maritime and inland nations. In developing countries, it is as an important source of food, employment, national income and foreign exchange earnings.

Fisheries sector in India is of economic importance in view of its resource potential, employment opportunities and export earnings. The global awareness of increasing food production for the exploding human population through aquaculture of finfish and shellfish is growing more and more in recent years.

In 1998-99, it contributed an estimated amount of Rs. 19,555 crores at current prices to the Indian Gross Domestic Product (GDP). It provided full time - employment to 7,38,400 persons and part-time employment to 7,13,700 persons. Besides, about a million people were engaged in several allied fishing activities like marketing of fish, repairing of nets, processing of fish and other activities (Anon, 2000).

India, with a production of 2.10 million tonnes (m.t) is in the second place, behind China, in the top ten-aquaculture fish producers in the world. Its share in the world cultured fish production of 35.59 m.t is 5.89 % that is far less compared to the share of 69.08 % by China (Santhanakrishnan, 2003).

For the success of India's economic reforms, foreign trade has a pivotal role to play in the economic growth (Swamy, 1993). The economic compulsions of the nation to shore up its foreign exchange earnings provide a perfect setting for the seafood industry to earn its rightful place on the economic map of the country

(Elias Sait, 1994). Fish and fishery products are the important food items for the large population spread throughout the world. Several fish producing countries, apart from meeting the demand in the domestic market, have been exporting fish products to many countries and are earning foreign exchange.

Trends in the exports of marine products (1961-1998) reveal that the total exports of marine products to various markets increased from a mere 15,732 T in 1961-62 to as high as 3,07,337 T in 1994-95. However, in the subsequent year the exports declined to 2,96,277 T. During the period 1996-99, there was a rise in the export, except in 1998-99 (GOI, 2000). The exports boosted up during 1999-2001 and in 2001-02, the exports declined registering a decline of 3.63 % in quantity and 7.56 % in rupee realization compared to that of previous year. The unit value realization also declined to Rs. 140.34 (US \$ 2.95) in 2001-02 from Rs. 146.29 (US \$ 3.22) in 2000-01 (Rama Mohan Rao and Prakash, 2000).

During the year 2001-2002, India exported a total quantity of 4,24,470 T of seafood worth of Rs. 5,957 crores. In terms of quantity, frozen fish constituted 42 % of export, while shrimp constituted 20 %, frozen squid 9 %, frozen cuttlefish 7% and other items 12 %. However, in terms of value, frozen shrimp contributes 69 % of our earnings. Frozen finfish, frozen squid, cuttlefish and other items constituted 12 %, 5.5 %, 4.7 % and 12.5 %, respectively (Bojan, 2003).

The changing global socio-economic scenario in the new millennium calls for a new approach in fisheries export development. In this situation, aquaculture, also referred to as ornamental fish farming is a promising alternative for employment and income generation in domestic market and export markets (Ambalika Ghosh, 2002). As with edible fish, ornamental fish consists of both freshwater and marine species, wild caught and cultured species as well as cold water and tropical species (Gerald Bassleer, 1994). Ornamental fish form an

important commercial component of fisheries as they meet aesthetic requirements and contribute to the quality of the environment (Swain *et al.* 2001). Aquarium keeping of fish began in 1805 and the first public aquarium was opened at Regent's Park in England in 1853. Thereafter, aquarium keeping picked up and by 1928 there were 45 display aquaria globally. There are over 500 public aquaria worldwide. However, the global market for ornamental fish for public aquarium is less than 1% at present and over 99% of the market for the ornamental fish continues to be confined to hobbyists (Swain *et al.* 2003).

Indian waters hold a rich diversity of ornamental fish, with over 100 varieties of indigenous species, in addition to a similar number of exotic species bred in captivity. Further, the vastness of India's natural ornamental fish resources offers great scope for their commercial exploitation. The seas around Lakshadweep and Minicoy Islands and Andaman and Nicobar Islands also have innumerable varieties of marine fishes, which have ornamental features. The coral reefs and bays of these islands are known to be the potential grounds having many beautifully coloured varieties of fishes.

The world trade of ornamental fish has been estimated to be around Rs. 20,700 crores in 1995 and is making further strides, with 10 % annual growth. USA is the largest market for ornamental fishes, importing fish worth over Rs. 2,300 crores every year, followed by the European Union and Japan (Swain *et al.* 2003). Though the major markets are developed countries, the production hubs are primarily concentrated in South-East Asia. As much as 69 % of the global trade in ornamental fishes originates in South-East Asia, where Singapore alone accounts for 35 % of the international trade (Ramachandran, 2002).

During 2001-2002, the Indian export earnings from ornamental fish was only to the tune of Rs. 3.14 crores, while the domestic market generated sales to

the extent of Rs. 12 crores. Against this, the global trade in ornamental fishes is to the extent of about Rs. 30,000 crores annually, of which 68 % is from Asian countries. Also, 85 % of the global trade is based on freshwater ornamental fishes and the rest by marine fishes (Mohan Joseph Modayil, 2003). In India, the domestic marketing of ornamental fish is promising. Freshwater fishes attract more attention than their marine counterparts. The demand for freshwater ornamental fishes, about 76,000 varieties is high, which constitutes about 80 % of the total domestic market demand. The exact number of saltwater species is not known; nevertheless their market is flourishing in terms of value (Sasi Nayar, 1996).

The demand for ornamental fish in the domestic market outstrips its supply thus indicating the large scope available for the production of ornamental fish. The investment required for establishing a small home unit for breeding and rearing of common economic species like guppy could be as low as Rs. 8,000 that would provide a monthly income of Rs. 3,000 (Ambalika Ghosh, 2002). The main advantage of this trade is that it could be developed both in the rural and urban areas. Unemployed youth, small and marginal farmers and landless labour can also adopt ornamental fish production to earn additional income and employment to family labour.

Information on the economics of production and marketing of ornamental fish could be very helpful to those who intend to take up production of ornamental fish on commercial lines. Many entrepreneurs hesitate to invest in this trade for want of information on the cost involved, income expected, breeding techniques, constraints, development assistance, etc.

This study addresses the major lacuna of lack of information on the economics of production and marketing of ornamental fish felt by many entrepreneurs.

1.1 Objectives of the study

The overall objective of the study is to apply alternative costing techniques in order to prioritize them and to price the products in ornamental farms in Thoothukkudi and Madurai districts.

Specifically, the objectives are

- i. to estimate the unit cost of production of selected ornamental fishes applying alternative methods of costing;
- ii. to price the selected ornamental fishes by cost plus method and compare the estimated prices with the actual selling prices for the different ornamental fishes;
- iii. to estimate a cost function on the basis of total cost and average cost; and
- iv. to compute profitability by deriving profit margin per unit of the selected products in the aquaculture units.

1.2 Scope of the study

The study is important both from the point of view of applied research and basic research in the field of aquaculture economics. Incidentally, aquaculture economics needs to be encouraged, as it is a fast emerging subject-matter-field of aquaculture economics. Thus, the methodology followed and the results obtained in the costing investigations could contribute to the methodology development in aquaculture economics, especially as it deals with complexities of ornamental fish trade.

1.3 Limitation of the study

The study covers ornamental fish farms and retail shops in Thoothukkudi and Madurai districts. The data on the costs and returns of ornamental fish production and marketing were collected during the year 2002-2003. Since the practice is sensitive to geographic factors, it is difficult to generalize the data. The estimation of joint cost is difficult with heterogeneity of production factors particularly the products and also because of recall bias. The spatial and temporal specificity renders generalisations to be made.

Chapter 2

CONCEPTS AND REVIEW OF LITERATURE

The concepts used in the present study are described first along with a short review of earlier studies.

2.1 Concepts

2.1.1 Cost

Subba Rao and Chowdry (1988) considered cost in fish culture farms as fixed investments on pond construction, farm sheds and oil engines and operational expenditure on seed, manures and supplementary feeds, water pumping, human labour, hire charges and interest on working capital. In the present study, costs are classified into fixed costs and variable costs.

2.1.1.1 Fixed costs

Kay (1981) defined the costs associated with owning a fixed resource as fixed costs. He included depreciation, interest, taxes and insurance as the components of fixed costs. Shang (1981) observed that fixed costs are those that do not change with the level of farming activity. These costs would be incurred, even if no output were produced. In the present study, fixed costs include the annual rent of the leased-in ponds/tanks or rental value of the land, depreciation on buildings, farm structures, farm equipments and machinery, interest on fixed capital and repairs and maintenance.

2.1.1.2 Variable costs

Wattanutchariya and Panayotou (1982) regarded variable costs as the costs that are actually paid and which vary with the quantity of fish produced. Shang (1984) considered variable costs as those items of costs that vary with the level of

production such as seed, feed, fertilizer, labour, power, fuel and supplies. In the present study, costs of preparation of fish culture ponds/tanks, stocking, feeding, harvesting, packaging, labour including watch and ward, power, medicines, fuel, hormones, transport charges, interest on variable cost and other incidental expenses are considered as variable costs.

2.1.1.3 Total cost

Christensen (1993) included variable costs and fixed costs under total cost. Suresh (1993) considered the sum of fixed costs and variable costs as total costs and the same is followed in this study.

2.1.2 Total returns

Ranadhir and Gopalakrishnan (1973) considered returns as the value of yield by the sale of fish. Returns from fish culture were usually expressed in terms of total returns by Suresh (1993), Christensen (1993) and Jayaraman (1995). In the present study, total returns represent total sale proceeds realized at the farm or in the market.

2.1.3 Net returns

Jayaraman (1995) considered net returns as total returns less all costs. Net returns in the present study were obtained by deducting total cost from total returns.

2.1 4. Input

In this study, the inputs are classified as physical inputs, labour inputs and energy inputs. Physical inputs are the material inputs like lime, manure, broodstock, fertilizer and feed used in production. Labour inputs denote family

labour or hired labour engaged for farm operations. Energy inputs include power and fuel like diesel and kerosene.

2.1.5 Output

It is the yield of fish from ponds/tanks counted in numbers

2.2 Review of Literature

Dey and Tomey (1988) discussed the importance of ornamental fishes in increasing our exports and on the resource potential of freshwater, brackishwater and marine ornamental fishes.

Felix (1989) estimated the economics of a small-scale aquaculture unit. The study highlighted the importance of ornamental fishes for export and identified the reasons for inadequate development of aquaculture in India.

According to Christopher Andrews (1992), 150 million ornamental fish are sold on a worldwide basis each year. The principal ways that might adversely affect populations of fish in the world were identified as introduction of non-native organisms and direct depletion of wild stock.

Gerald Bassler (1994) reported that the market for ornamental fishes consisted of 99 % home-hobbyists and 1 % public aquaria and research institutes. The market was mostly located in areas with dense population, industrial areas and cool climate. Aquarium fishes could fetch about 100 times more price than food fishes and marine ornamentals were about ten times costlier than their freshwater counterparts.

Jameson and Santhanam (1996) worked out the economics of ornamental fish farming. Rapid development in the ornamental fish farming technology would be a boon to the national economy. The technology on commercial ornamental

fish culture needs popularization in order to take it to commercial level and to promote export and earn foreign exchange.

Sasi Nayar (1996) emphasized the importance of ornamental fish culture. The freshwater ornamental fishes were found to attract more attention than marine counterparts and the demand for freshwater fishes constituting about 76,000 different kinds of saleable fishes was about 80 % of the total demand.

Ninawe (1997) reported that India has a great potential to increase the level of exports to about US \$ 30 million (about Rs. 110 crores) every year.

Jayasankar (1998) reported the current status and prospects of ornamental fish culture in India. There has been considerable growth and diversification in the international trade in ornamental fishes valued at about US \$ 5 billion annually during the last four decades. The major players in this market are USA, Europe, Japan, Australia, Singapore, Indonesia, Philippines and Sri Lanka.

Elamparithy (1999) analysed the prospects and problems in Indian ornamental fish farming. India is blessed with abundant resources of ornamental fish that offer a very strong and powerful buying as well as selling market for the fishes and for the farm accessories. The business provides vast scope for development of export trade and with adequate investment, technical know-how and managerial skill export trade could fetch more foreign exchange to the country.

Devin Bartley (2000) discussed the responsibilities that need to be taken to improve the ornamental fish farming and listed some important international organizations concerned with the enterprise.

Dey (2000) estimated the economics of an ornamental fish exporting unit. The ornamental fishes of freshwater and marine origin fetched Rs. 8-10 per kg (100-200 numbers) in the domestic market, while their export value was 20 times more, indicating huge loss in foreign exchange.

Madhumita Mukherjee *et al.* (2000) reported on the ornamental fish export trade in West Bengal. They found that manual collection was the predominant method of collecting aquarium fishes by fishermen.

Shaleesha and Stanley (2000) made an innovative approach on the involvement of rural woman in aquaculture. They concluded that to utilize the full potential of aquaculture, it was necessary to provide capacity building to rural women, which would eventually lead to their empowerment. They gave some practical tips for dissemination of technology in the rural sector, particularly to rural women. Also, they reported that a project on backyard ornamental fish breeding and management had been found to offer immense scope for improving the livelihood of rural women.

Swain *et al.* (2001) estimated the economics of small-scale breeding and rearing units for live-bearing ornamental fishes. They emphasized the importance of breeding commercial live-bearing ornamental fishes for the beginners.

Ambalika Ghosh (2002) reported that the present trend of domestic market for ornamental is promising. He also noticed that the demand far exceeds the supply and it could be practiced in urban areas too. Moreover, landless fish farmers could adopt this type of farming.

Das and Archana Singh (2003) studied the possibilities of ornamental fish trade in India. The study revealed that India has resources that need to be properly utilized for more foreign exchange earnings and for upgrading livelihood of

ornamental fish farmers and entrepreneurs. It also emphasized that the trade has a sizeable potential for employment that could be harnessed by way of training more and more manpower in the trade. Additionally, for refining and expanding the technology, it becomes essential to strengthen the research and extension activities pertaining to production and marketing of ornamental fishes.

Swain *et al.* (2003) discussed the prospects of ornamental fish breeding and rearing along with problems associated. Emphasis must be laid on systematic cataloguing of commercially important aquarium fishes, bringing in new species for diversification, detailed studies on breeding, biology and behaviour aspects, nutrition and feed formulations, disease diagnostics and comprehensive health management, fabrication of aquarium associated equipments and also on education and creation of public awareness.

Chapter 3

DESIGN OF THE STUDY

The choice of research method does have an influence on the inferences drawn from the analysis of data. This chapter describes the rationale of the design of the study. It explains the choice of the study area, how the respondents were selected and how the inputs and output were measured in physical as well as monetary units.

3.1 Choice of the study area

Thoothukkudi, a maritime district and Madurai, an inland district, both in South Tamil Nadu, were purposively chosen for the study considering the familiarity the researcher has with the aquaculture farmers and market intermediaries in the area, besides time and logistic considerations. The districts represent different agro-climatic conditions. Thoothukkudi has fisheries endowments; particularly marine fisheries including pearl and chank resources. Madurai, on the other hand, is largely agrarian and offers a huge market for many goods and services including food and aquarium fishes.

3.2 Selection of the respondents

Over 95 % of the aquaculture farms/farmers and over 85 % of the retailers who trade in ornamental fishes were selected as respondents for the survey. Neither the government nor any private organization has documented complete information either on the aquaculture farms or on the market intermediaries in

the study area. Therefore, almost all the operational fish farms in and around Thoothukkudi (9 farms) and Madurai (22 farms) cities were selected. Data on the marketing of ornamental fishes were collected from nine retailers in Thoothukkudi district and from 10 retailers in Madurai district. They represent 85 % of the traders in the area.

3.3 Collection of primary data

Survey method was followed to collect primary data required for the study. Survey schedules were prepared and pre-tested in a pilot survey before administering them in field survey. The primary data were collected from the respondents by personal interviews after explaining to them the objectives of the study. Since, fish farmers do not maintain farm records; particularly on costs and returns for obvious reasons, the respondents provided the information by "memory recall". The information was cross-checked, wherever possible to minimise recall bias. Discussions with technical experts, officials of the MPEDA, State fisheries department and banks were held to collect additional information on the status of ornamental fish farming and trade.

3.4 Secondary data

Published information on district profiles was collected from the website www.tn.nic.in. Secondary data on production and international trade in ornamental fishes were collected from periodicals, internet resources, books and MPEDA publications.

Ornamental fishes are broadly classified as egg-layers and live bearers. Different breeding techniques are followed in ornamental fish farming. Although

the breeders hesitated to reveal the exact technical details of breeding, general information was collected on how the different ornamental fishes were bred.

3.5 Estimation of costs, yield and returns

3.5.1 Fixed costs

Fixed costs include lease money of breeding tanks/cisterns or rental value of land, depreciation of capital items like farm structures, equipments and implements, interest on fixed capital and repairs and maintenance.

3.5.1.1 Rental value or lease money

The rental value of an ornamental fish farm is the prevailing lease value in the adjacent area for which 10 % of the value was taken. The annual rent of leased-in ornamental farms was also included.

3.5.1.2 Depreciation

Depreciation on all capital items like motors, pipes/gate-valves, nets, cement cisterns, tanks, sheds and buildings was computed using straight line method and the rates varied from 10 % to 15 %.

3.5.1.3 Interest on investment

Interest on fixed capital was worked out at 10 % per annum.

3.5.1.4 Repairs and maintenance

This includes the actual annual cost of maintenance of capital items used in aquaculture.

3.5.2 Variable costs

Costs of all the inputs used in breeding and rearing of ornamental fishes like feed, labour, packaging material, medicines, hormones, power etc. constituted variable cost.

3.5.3 Total costs

It is the sum of fixed costs and variable costs in aquaculture.

3.5.4 Production

Production refers to the estimated number of fish harvested for each species/variety in a year.

3.5.5 Total returns

Production times the farm gate price of ornamental fish is total returns.

3.5.6 Net returns

It is the difference between total returns and total costs.

3.6 Tools of analysis

Simple tools of analysis like percentage analysis were used in the study. Owing to the constraints imposed by the behaviour of data, conventional production function could not be estimated. Instead, tabular analysis of costs and returns was made to estimate the economics of aquaculture in the study regions.

The technique of ascertaining cost is known as “ Costing ” and cost ascertainment is the primary objective of cost accounting (Sharma,1992). Costs may be ascertained under different circumstances using any of the costing principles such as variable cost of production, total cost of production and unit cost of production, all including apportionment of joint costs and opportunity costs. In the present study these techniques were used in the estimation of production cost.

Costing techniques differ according to the nature of the activities engaged and the objectives of management. The management is able to further the return maximisation from resources by bringing economy in their use or increasing their productivity.

The objectives of costing techniques are:

1. to estimate production costs in management situations involving joint products;
2. to determine net returns product-wise;
3. to price the products following cost-plus method; and
4. to compare the margins realized in the sale of each product by the farmers.

For each species, apportioned total cost was used for computing mark-up and net returns for all fishes in both the districts. Apportioned variable cost alone was used for the computation for 13 fishes produced by more than 10 farms in Madurai district . The percentage of profit on the average actual selling price was considered as the mark-up. The economics of each species based on the actual mark-up is considered for discussion.

Total cost and variable cost functions were estimated using regression analysis to estimate the marginal cost of the variables and to know the relationships between the costs and production. In the case of production of species/varieties for which the marginal cost was higher than the price, the prevailing price was marked-up by 25 % and 50 % to know if it could make their production profitable.

Chapter 4

DESCRIPTION OF THE STUDY AREA

This chapter describes the area of the study and its setting so as to interpret the results of the investigation. With an understanding of the salient features of the resource endowments in the area, the performance can be assessed. The location of the farm, rainfall, temperature, water source, soil, human resources and support services have an influence on ornamental fish culture.

4.1 Thoothukkudi district

4.1.1 Location

The Thoothukkudi district is situated in the extreme South-East corner of Tamil Nadu. It is bounded in the North by the districts of Tirunelveli, Virudhunagar and Ramanathapuram in the East and South-East by the Gulf of Mannar and in the West and South-West by the district of Tirunelveli. The total area of the district is 4,621 sq. km. The district has seven taluks viz., Srivaikundam, Trichendur, Sathankullam, Kovilpatti, Ettayapuram, Vilathikulam and Ottapidaram. The map showing the study area is given in Fig.1.

4.1.2 Climate and Rainfall

The climate is influenced by South-West monsoon (June-September) and North-East monsoon (October-November). During South-West monsoon, an average precipitation of 57.88 mm and during North-East monsoon a precipitation of 286.52 mm occurs in the district. The average precipitation reported in winter is 27.49 mm and 141.57 mm in summer. The average annual rainfall is 513.46 mm.

4.1.3 Population

The district has a total population of 15,65,743 persons and the density per sq.km is 338. The proportion of effective literacy rate is 59 %.

4.1.4 Land

Lands are utilized for various purposes. The net area sown is 42.0 %, which indicates the predominance of agriculture in the district. The areas under forest, barren and uncultivable and non-agriculture land, cultivable wasteland and permanent pastures and other grazing land are 11.002 ha (2.4 %), 19.944 ha (4.3%), 68.573 ha (15 %), 20.154 ha (4.4 %) and 5.052 ha (1.1 %), respectively. The cultivable waste can be reclaimed for farming or other uses.

4.1.5 Sources of water

Bore wells, open wells and corporation water supply lines are the main sources of water in the district.

4.2 Madurai district

4.2.1 Location

Madurai district is situated in the South of Tamil Nadu and bounded on the North by the districts of Dindigul, Tiruchirapalli and in the East by Sivagangai and in the West by Theni and in the South by Virudhunagar. Covering an area of about 3741.73 sq.km, it is located between 9° 30 and 10° 30 of the Northern latitude and between 77° 00 and 78° 30 of the Eastern latitude. The district has seven taluks viz., Usilampatti, Vadipatti, Peraiyur, Thirumangalam, Madurai (North and South) and Melur. The map showing the study area is given in Fig.2.

4.2.2 Climate and Rainfall

The climate is influenced by South-West monsoon from June-September and the North-East monsoon from October to November. The average annual rainfall is 857.80 mm. During South-West monsoon, an average precipitation of

282.10 mm and during North-East monsoon a precipitation of 399.30 mm occurs in the district. The average precipitation reported in winter is 33.40 mm and in summer, 143.00 mm.

4.2.3 Population

The population is 25,62,279 persons comprising 12,86,124 males and 12,76,155 females (2001). Of them, 11,29,028 are in rural areas and 14,33,251 in urban areas. The density of population is 733 per sq. km and the number of literates is 17,97,751. The main sources of employment are agriculture and allied activities and non-household manufacturing industries.

4.2.4 Source of water

The main sources of water for ornamental fish culture are bore wells, open wells and corporation water supply.

4.3 Ornamental fish culture

As ornamental fish farming is a flourishing income generating activity, it is adopted by those having interest and technical knowledge. The reason behind the adoption of ornamental fish farming is that, the people are basically fish hobbyists and they later turn to commercial farming. Also, without huge investment it can be followed as it yields more returns compared to the agriculture enterprises in the district.

4.4 Support services

4.4.1 Inputs

Regarding inputs, broodstock and feed form the major items. The major suppliers of ornamental fishes for both the districts are in Chennai. Occasionally, they get fry of ornamental fishes from nearby districts. Among fish feeds, live feed is the most important one, which includes *Artemia* nauplii, *Daphnia*, bloodworms and *Infusoria*. Bloodworms and *Daphnia* are collected from drains and polluted

freshwater bodies where as, *Artemia* are collected from salt pans. In addition to the above, homemade feeds and pellet feeds are also used. Other inputs are obtained from private dealers in the area.

4.4.2 Marketing

Meeting local demand is easy. Retailers and ornamental fish rearers have a direct link with the ornamental fish farm dealers. They sell fish for cash or on credit. The demand for ornamental fishes far outstrips its supply.

4.4.3 Credit

Aquaculture is a priority area for credit and banks offer credit to entrepreneurs.

4.4.4 Agencies

The Marine Products Export Development Authority (MPEDA) organizes ornamental trade fairs and maintains statistical data on the exports of ornamental fishes and also provides subsidies for the development of this sector. The major institute concerned with research and extension activities in the fields of ornamental fish farming is the Tuticorin-based Fisheries College and Research Institute of the Tamil Nadu Veterinary and Animal Sciences University and local offices of Tamil Nadu Fisheries Development Corporation (TNFDC) and Fisheries Training Centre (FTC) of the State Department of Fisheries.

4.4.5 Other facilities

Other facilities like power, transport, banks and communication are also available. Free power/concessional supply is given for agricultural operations; but for ornamental fish culture industrial power tariff is charged.

Chapter 5

RESULTS AND DISCUSSION

This chapter describes the results of analysis of the data collected from ornamental fish farmers and retailers on general characteristics of the sample farms, retail shops, costs and returns of ornamental fish farming, marketing and constraints in ornamental fish farming and trade in Thoothukkudi and Madurai districts. The inferences drawn are presented and discussed.

The chapter is organised under the following heads:

5.1 General characteristics of the sample

5.2 Economics of aquaculture

5.3 Cost-plus pricing in aquaculture

5.4 Cost function analysis

5.5 Marketing channel

5.6 Constraints

5.7 Policy suggestions

5.1 General characteristics of the sample

The general characteristics of the sample of Thoothukkudi and Madurai districts may be classified under the following headings:

5.1.1 Age of the farmers and retailers

5.1.2 Experience in ornamental fish culture and trade

5.1.3 Educational status

5.1.4 Occupational status

5.1.5 Farm size

5.1.1 Age of the farmers and retailers

5.1.1.1 Age of the farmers and retailers – Thoothukkudi district

The age distribution of the respondent-farmers and retailers is given in Table 1. It could be observed that all of them were aged above 20 years. Most of the farmers (44 %) fell under 31-35 age class. Most of the retailers (87 %) were aged over 31 years.

Table 1. Age of the farmers and retailers

(n = 9)

Age class in years	Number of farmers reported	%	Number of retailers reported	%
Below 20	--	--	--	--
21 – 25	1	11.11	1	11.11
26 – 30	1	11.11	1	11.11
31 – 35	4	44.44	3	33.33
36 – 40	1	11.11	1	11.11
Above 40	2	22.22	3	33.33

5.1.1.2 Age of the farmers and retailers – Madurai district

Table 2(a). Age of the farmers

(n = 22)

Age class in years	Number of farmers reported	%
Below 20	--	--
21 – 25	1	4.5
26 – 30	3	13.6
31 – 35	6	27.3
36 – 40	2	9.1
Above 40	10	45.5

Table 2(b). Age of the retailers

(n = 10)

Age class in years	Number of retailers reported	%
Below 20	--	--
21 – 25	--	--
26 – 30	3	30
31 – 35	3	30
36 – 40	1	10
Above 40	3	30

Table 2 (a) and (b) show the age distribution of the respondent farmers and retailers of Madurai district. Most of the farmers (46 %) were aged above 40 years while only 10 % of the retailers were in the 36-40 age class.

5.1.2 Experience in ornamental fish culture and trade

5.1.2.1 Experience in ornamental fish culture and trade – Thoothukkudi district

Table 3. Experience of the farmers and retailers

(n = 9)

Experience in years	Number of farmers and retailers reported				%			
	Ornamental fish culture and trade		Allied activities		Ornamental fish culture and trade		Allied activities	
	F	R	F	R	F	R	F	R
0 – 5	3	3	4	1	33.33	33.33	50	20
6 – 10	3	4	2	1	33.33	44.44	25	20
11 – 15	1	1	--	2	11.11	11.11	--	40
Above 15	2	1	2	1	22.22	11.11	25	20

F – Farmer R – Retailer

Table 3 shows the experience of the respondent-farmers in ornamental fish culture and allied activities. About 67 % of them had 1-10 years of experience in ornamental fish culture. Fifty percent of the farmers had 2-5 years of experience in allied activities. From the table, it could be observed that about 44 % of the retailers had 6-10 years of experience in ornamental fish trade, while 40 % of the traders had 11-15 years experience in the allied activities.

5.1.2.2 Experience in ornamental fish culture and trade – Madurai district

Table 4(a). Experience of the farmers

(*n* = 22)

Experience in years	Number of farmers reported		%	
	Ornamental fish culture	Allied activities	Ornamental fish culture	Allied activities
0 – 5	5	2	22.7	25.0
6 – 10	6	2	27.3	25.0
11 – 15	6	1	27.3	12.5
Above 15	5	3	22.7	37.5

The proportion of farmers in each of the four experience classes is furnished in Table 4 (a). About 55 % of the farmers had 6-15 years of experience in ornamental fish culture. In addition, 50 % of the farmers were also engaged in allied activities having an experience of 1-10 years.

Table 4(b). Experience of the retailers

(*n* = 10)

Experience in years	Number of retailers reported		%	
	Ornamental fish trade	Allied activities	Ornamental fish trade	Allied activities
0 – 5	5	--	50	--
6 – 10	2	2	20	66.66
11 – 15	2	1	20	33.33
Above 15	1	--	10	--

About 50 % of the retailers were engaged in ornamental fish trade with an experience of about 5 years (Table 4(b)). While considering allied activities, 67 % of the retailers had 6-10 years of experience.

5.1.3 Educational status

5.1.3.1 Educational status of the farmers and retailers – Thoothukkudi district

Table 5. Educational status of the farmers and retailers

(n = 9)

Education	Number of farmers and retailers reported		%	
	F	R	F	R
Primary school	--	--	--	--
Secondary school	--	2	--	22.22
Higher secondary school	2	1	22.22	11.11
College	7	6	77.77	66.66
Total literate	9	9	99.99	99.99
Illiterate	--	--	--	--

F – Farmer R – Retailer

Table 5 shows the literacy level of the respondent-farmers and retailers. All the farmers were literates and most of them (78 %) have studied up to college degree level. About 67 % of the retailers studied up to college degree level and none of the respondents were illiterates.

5.1.3.2 Educational status of the farmers and retailers – Madurai district

The literacy level of the respondent-farmers in Madurai district could be seen in Table 6(a). All the farmers were literates with only 9 % studied up to primary level.

Table 6(b) shows the literacy level of the respondent-retailers. About 50 % of them had college level education. Another half of them had received secondary and higher secondary school education.

Table 6(a). Educational status of the farmers

(n = 22)

Education	Number of farmers reported	%
Primary school	2	9.09
Secondary school	6	27.27
Higher secondary school	7	31.82
College	7	31.82
Total literate	22	100.00
Illiterate	--	--

Table 6(b). Educational status of the retailers

(n = 10)

Education	Number of retailers reported	%
Primary school	--	--
Secondary school	2	20
Higher secondary school	3	30
College	5	50
Total literate	10	100
Illiterate	--	--

5.1.4 Occupational status

5.1.4.1 Occupational status of the farmers and retailers – Thoothukkudi district

Table 7(a) presents the occupational status of the respondent farmers. About 44% of them had ornamental fish culture as their primary occupation. The remaining respondents had agriculture (11 %) and other avocations as their

primary occupation. About 56 % of them practiced ornamental fish culture as their secondary occupation.

Table 7(a). Occupational status of the farmers

(n = 9)

Occupation	Rank	Primary		Secondary	
		Number of farmers reported	%	Number of farmers reported	%
Ornamental fish culture	I	4	44.44	5	55.55
Others	II	4	44.44	4	44.44
Agriculture	III	1	11.11	--	--
Business	IV	--	--	--	--

About 78 % of the respondent-retailers had ornamental fish trade as their primary occupation. The remaining respondents were equally distributed between business and other avenues as shown in Table 7(b).

Table 7(b). Occupational status of the retailers

(n = 9)

Occupation	Rank	Primary		Secondary	
		Number of retailers reported	%	Number of retailers reported	%
Ornamental fish trade	I	7	77.77	2	22.22
Others	II	1	11.11	2	22.22
Business	III	1	11.11	--	-
Agriculture	IV	--	--	--	--

5.1.4.2 Occupational status of the farmers and retailers – Madurai district

The occupational status of the respondent-farmers in Madurai district is furnished in the Table 8(a). About 86 % of them had ornamental fish culture as their primary occupation.

Table 8(a). Occupational status of the farmers

(n = 22)

Occupation	Rank	Primary		Secondary	
		Number of farmers reported	%	Number of farmers reported	%
Ornamental fish culture	I	19	86.36	3	13.64
Others	II	3	13.64	2	9.09
Agriculture	III	1	11.11	4	18.18
Business	IV	--	--	1	4.55

From the Table 8(b) it could be observed that only 10 % of the respondent - retailers were engaged in other business while most of them had ornamental fish trade as their primary occupation.

Table 8(b). Occupational status of the retailers

(n = 10)

Occupation	Rank	Primary		Secondary	
		Number of farmers reported	%	Number of farmers reported	%
Ornamental fish trade	I	9	90	1	10
Business	II	1	10	1	10
Others	III	--	--	1	10
Agriculture	IV	--	--	--	--

5.1.5 Farm size

5.1.5.1 Farm size – Thoothukkudi district

The farms were categorized into institutionally based and non-institutionally based ornamental fish culture units. They were further classified into big and medium size farms.

While about 78 % of the selected farms fell under non-institutionally based units, only 22 % of them were institutionally based units as in Table 9.

Table 9. Classification of farms

Area in ha	Number of ornamental fish farms	%	Total area in ha
1. Institutionally - based units			
a. up to 0.5	2	22.22	0.075
b. above 0.5	--	--	--
2. Non-institutionally based units			
a. up to 0.5	6	66.66	1.205
b. above 0.5	1	11.11	2.86
Total	9	100.00	4.14

5.1.5.2 Farm size – Madurai district

The selected farms in Madurai district were classified into leased-in and non-leased in farm units (Table 10). The non-leased units had a major portion (82 %) covering an area of about 7.395 ha. The remaining farms (0.37 ha) were leased-in units.

Table 10. Classification of farms

Area in ha	Number of ornamental fish farms	Percentage	Total area in ha
1. Leased-in units			
a. ≤ 0.5	4	18.18	0.370
b. > 0.5	--	--	--
2. Non-leased in units	4	18.18	0.050
a. < 0.025 (S)	13	59.09	4.945
b. ≤ 2-0.025 (M)	1	4.55	2.400
c. > 2 (B)			
Total	22	100.00	7.765

5.2 Economics of aquaculture

5.2.1 Thoothukkudi district

The average variable cost was Rs. 2,27,968 consisting of wages Rs. 68,500 (30 %), feed Rs. 59,024 (26 %), broodstock Rs. 36,111 (16 %), power Rs. 24,333 (11 %), interest on variable cost Rs. 16,888 (7 %), others Rs. 16,411 (7 %) and oxygen packing Rs. 6,700 (3 %) (Table 11(a)). The various items of the average fixed cost were, interest on capital cost Rs. 4,42,228 (39 %), depreciation Rs. 37,718 (33 %), repairs and maintenance Rs. 21,272 (19 %) and rent Rs. 10,694 (9 %) (Table 11(b)).

The estimated total cost in aquaculture was Rs. 30,75,820 of which total variable cost and total fixed cost accounted for 67 % and 33 %, respectively (Table 11(c)). The average total cost was Rs. 3,41,758 consisting of Rs. 2,27,968 total variable cost and Rs. 1,13,790 total fixed cost. The total returns and average returns were Rs. 41,63,900 and Rs. 4,62,656, respectively. The net returns and average net returns were Rs. 10,88,081 and Rs. 1,20,898 respectively. The cost

benefit ratio on total cost and total variable cost bases were 1.35 and 2.03, which indicated that for every rupee of investment, a return of Rs. 1.35 and Rs. 2.03 on the respective basis was obtained. The aquaculture business was thus profitable.

5.2.2 Madurai district

The average variable cost was Rs. 3,11,043 consisting of wages Rs. 1,03,123 (33 %), feed Rs. 62,345 (20 %), others Rs. 54,977 (18 %), broodstock Rs. 31,932 (10 %), power Rs. 20,689 (7 %), interest on variable cost Rs. 23,040 (7 %), and oxygen packing Rs. 14,936 (5 %) (Table 12(a)). The various items of the average fixed cost were interest on capital cost Rs. 30,443 (36 %), depreciation Rs. 23,927 (28 %), repairs and maintenance Rs. 17,877 (21 %) and rent Rs. 13,139 (15 %) (Table 12(b)). The total returns and average returns were Rs. 1,11,02,500 and Rs. 5,04,659 respectively. The net returns and average net returns were Rs. 23,81,070 and Rs. 1,08,230 respectively. The cost benefit ratio on total cost and total variable cost bases were 1.27 and 1.62 respectively (Table 12(c)).

5.3 Cost-plus pricing of ornamental fish production

Ornamental fishes like guppy, molly (ordinary and balloon), platy (ordinary and others), swordtail, gold (ordinary and others), koi, gourami, fighter, angel, oscar, cichlids, barbs (rosy barb, tiger barb and others) and other varieties were reported in the study regions. While apportioned total cost was used for computing mark-up and net returns for all fishes, apportioned variable cost was used for the computation for 13 fishes produced by more than 10 farms in Madurai district.

5.3.1 Thoothukkudi district

For computing mark-up and net returns, apportioned total cost was used for all the ornamental fishes under the purview of the investigation. Of the nine respondent-farmers, seven produced guppy at the unit cost of production varying from Rs. 1.29 to Rs. 3.14, with the mean of Rs. 1.47 (Table 13). Fishes were sold at the rate of Rs. 2.06, on an average, with the selling price ranging between Rs. 2.50 and Rs. 3.00. The highest and lowest levels of output were 1,000 and 15,000 numbers, respectively, with an average yield of 4,500 numbers. The mean mark-up by cost-plus method was 37.98 %, with the highest and lowest estimates as 94.49 % and -4.42 % respectively. The net returns on the basis of total cost varied from Rs. -693.35 to Rs. 13,251.02, with a mean of Rs. 3,695.96. The recently established farm in Sawyerpuram showed a negative net returns.

Ordinary molly was produced by seven respondent-farmers with the unit cost of production ranging between Rs. 1.03 and Rs. 3.14 for one fish and the mean was Rs. 1.34 (Table 13). The average selling price of the fish was Rs. 1.83 and it varied from Rs. 2.00 to Rs. 3.00. The mark-up ranged between -4.42 % and 94.50 %, averaging 37.98 %. The negative mark-up was, because the farms had been established very recently. The level of production varied from 1,500 to 15,000 numbers with the overall mean of 4,778. The net returns, on an average, came to Rs. 2,716.69 with the lowest and highest estimates of Rs. -693.35 and Rs. 9,716.96 respectively. For the very newly established farms, production and marketing of the species resulted in net loss.

Balloon molly was produced by 56 % of the respondent-farmers with a mean level of production of 11,389 numbers, ranging from 7,500 to 45,000 numbers (Table 13). The unit cost of production varied from Rs. 1.80 to Rs. 5.23, with the overall mean of Rs. 1.70. The lowest price was Rs. 3.50 and the highest

price Rs. 5.00 and the fish was sold for Rs. 2.50, on an average. The lower limit of mark-up was at -4.42% and the upper limit at 94.49% , with 33.25% as average. The net returns ranged between Rs. $-3,466.74$ and Rs. $1,01,879.80$ and the mean estimate was Rs. $18,987.45$.

The unit cost of production for ordinary platy varied from Rs. 1.02 to Rs. 3.14 with the mean of Rs. 1.24 (Table 13). Farmers sold the fish for Rs. 1.67, on an average, and the selling price ranged between Rs. 2.00 and Rs. 3.00. The average mark-up was 30.01% varying from -4.42% to 94.49% . The mean level of production was 3,478 numbers with the highest production of 15,000 numbers and the lowest of 1,000 numbers. The net returns varied from Rs. -277.34 to Rs. $14,575.43$ with the overall average of Rs. $2,412.80$.

Other platy varieties were produced by 56% of the producer-farmers. The average unit cost of production was Rs. 1.87 with the lowest cost of Rs. 2.06 and the highest cost of Rs. 5.23 (Table 13). The fishes were sold at prices ranging between Rs. 4.00 and Rs. 6.00, with an average of Rs. 2.78. The highest and the lowest mark-ups were 94.49% and -4.42% , with the mean of 33.25% respectively. The peak output was 21,500 numbers and the trough 2,000 numbers, with the overall average of 7,556 numbers. The average net returns were Rs. $10,880.92$ and inter-farm variation was of the magnitude Rs. -4160.09 to Rs. $44,911.48$.

The number of producer-farmers of swordtail was seven. The selling price varied from Rs. 2.50 to Rs. 5.00, with Rs. 3.00 overall (Table 13). For producing one fish, the production cost varied from Rs. 2.04 to Rs. 3.23 and the average cost was Rs. 2.03. The mean mark-up was 37.98% , the highest and lowest being 94.49% and -4.42% respectively. The production level varied from 2,500 to

5,000 numbers, with an overall average of 3,333. The net returns came to Rs. 4,122.09, on an average, ranging between Rs. –693.35 and Rs. 12,146.19.

While 44 % of the farmers were producing ordinary gold, only 22 % of them were interested in producing other gold varieties like lion head, black moor and bubble eyed. For ordinary gold, the farm gate price varied from Rs. 3.00 to Rs. 15.00, with the mean of Rs. 4.00, while other varieties were selling at Rs. 15.00, with the mean of Rs. 3.33 (Table 13). The average unit cost of production came to Rs. 2.42 varying from Rs. 2.43 to Rs. 8.73 for ordinary gold fish. For other gold fish, the cost of producing a single fish was little higher, Rs. 9.70 at the most and Rs. 8.21 at the least, the average unit cost of production being Rs. 1.99. The highest mark-up for both varieties was 82.75 %. Ordinary gold showed the lowest mark-up of 23.21 %, while for other varieties it was 55 %. The mean mark-up for ordinary gold fish and other varieties was 25.82 % and 15.27 % respectively. The level of production for ordinary gold fish varied from 1,500 to 8,500 numbers, with the mean of 2,150. The average production was 500 with a range of 2,000 to 2,500 numbers for other gold fish. The estimated net returns varied from Rs. –1,978.30 to Rs. 39,793.66, with the mean of Rs. 9,231.86 for ordinary gold fish. For other gold fish varieties, while the highest net returns were Rs. 16,979.97, the lowest net returns was Rs. 10600.81, with the mean of Rs. 3,064.53.

The unit cost of production for koi ranged from Rs. 3.87 to Rs. 5.23, averaging Rs. 1.59 (Table 13). The farmers sold the fish for Rs. 2.00, on an average, ranging from Rs. 5.00 to Rs. 8.00. The mark-up per fish was 8.81 %, varying from –4.42 % to 55 %. The output level varied from 1,500 to 10,000 numbers, with the average of 2,389 numbers. The mean net returns were Rs. 1,465.47, ranging from Rs. –2,311.16 to Rs. 11,260.04.

Gourami was produced by 22 % of the respondent-farmers. The unit cost of production came to Rs. 0.59, on an average, ranging from Rs. 2.59 to Rs. 2.74 (Table 13). The range of price was to the tune of Rs. 5.00 to Rs. 4.00 and the fish was sold at Rs. 1.00, on an average. As the overall average mark-up was 15.27%, the highest and the lowest levels were 54.65 % and 82.75 %, respectively. The level of output ranged from 500 to 2,000 numbers with an average of 278. The net returns varied from Rs. 706.72 to Rs. 4527.99, with the mean of Rs. 581.63.

Among egg layers, fighter fish ranked first in terms of production produced by 78 % of the respondent-farmers in Thoothukkudi district. Male fighter was preferred over the female ones. The males had high demand reflected in the selling price. Farmers sold the fish between Rs. 2.00 and Rs. 10.00, with the mean of Rs. 5.56 (Table 13). The highest unit cost of production was Rs. 6.47 and the lowest was Rs. 1.55, with the mean of Rs. 3.72. The mark-up percentage varied from – 4.04 to 82.75, averaging 35.68. The mean output level was 25,322 numbers ranging from 1,400 to 2,00,000 numbers. The estimated net returns averaged Rs. 19,564.79, showing variation from Rs. –295.60 to Rs. 90,080.28.

Angel, as the name implies, is very beautiful and attractive and is normally placed in glass tanks in pairs. Some farmers were still facing difficulties in breeding the fish. The unit cost of production varied from Rs. 2.98 to Rs. 3.10, with the mean of Rs. 0.68 (Table 13). At farm level, the fishes were sold at the rate of Rs. 4.00 to Rs. 5.00, with Rs. 1.00, as the mean. The average mark-up was 10.74 %, ranging between 29.07 % and 67.60 %. The mean net returns of Rs. 18,733.20 varied from Rs. 60,502.45 to Rs. 1,08,096.30, with production ranging between 30,000 to 1,20,000 numbers, averaging 16,667 numbers.

Breeding oscar is still difficult for the respondent-farmers in Thoothukkudi district and hence, produced by only one farmer with the production of 50,000 numbers. The selling price and unit cost of production was Rs. 5.00 and Rs. 3.87, respectively (Table 13). The mark-up percentage was 29.07 with net returns of Rs. 56,300.18.

Of the producer-farmers in the district, six of them were producing cichlids and selling them at prices varying from Rs. 10.00 to Rs. 12.00, with the mean of Rs. 7.56 (Table 13). The unit cost of production varied from Rs. 5.47 to Rs. 10.46, with the mean of Rs. 5.13. The mark-up ranged between -4.42 % and 94.49 %, with the mean of 36.48 %. The average production of 10,833 numbers, lays within the range of 1,000 to 60,000 numbers. The highest and lowest net returns were Rs. 1,62,144.50 and Rs. -11,555.80 respectively, with the overall mean of Rs. 23,966.10.

The estimates for barbs are discussed under rosy, tiger and other barbs. The farmers sold the rosy and tiger barbs at rates ranging between Rs. 1.50 and Rs. 2.50 and other barbs at Rs. 2.00, averaging to Rs. 1.06, and Rs. 0.89 respectively (Table 13). For both rosy and tiger barbs, the lowest unit cost of production were Rs. 0.77, while for others, it was Rs. 1.09. The highest per unit production cost estimates for rosy, tiger and other barbs were Rs. 1.37, Rs. 2.09 and Rs. 1.55, with the corresponding overall mean of Rs. 0.64, Rs. 0.76 and Rs. 0.57 respectively. The mean mark-up percentages were 36.97, 27.28 and 26.47 for rosy, tiger and other barbs respectively. The lowest mark-up for both rosy and other barb was 29.07 %, while it was -4.42 % for tiger barb. For rosy and tiger barbs, the highest mark-up was the same (94.49 %), but for other barbs it was 82.75 %. The production level for rosy and tiger barbs varied from 500 to 15,000

and 10,000 numbers, with the overall mean of 2,222 and 2,278 numbers respectively. The output range was between 1,000 and 17,000 numbers for other barbs, averaging 2,333 numbers. The net returns for rosy, tiger and other barbs varied from Rs. 353.36 to Rs. 5067.02.93, Rs. -462.23 to Rs. 3,378.01 and Rs. 706.72 to Rs. 7,656.82, with the overall mean of Rs. 1,012.78, Rs. 801.66 and Rs. 1,219.48 respectively.

5.3.2 Madurai district

In Madurai district, guppy was produced by eighteen respondent-farmers with the unit cost of production ranging between Rs. 0.58 and Rs. 2.29 for one fish, with the mean of Rs. 1.28 (Table 14). The average selling price of the fish was Rs. 1.70 and it varied from Rs. 1.00 to Rs. 3.00. The mark-up by cost plus method ranged between -6.56 % and 102.27 %. The negative mark-up was because the farms had been established very recently. The level of production varied from 500 to 50,000 numbers, with the overall mean of 5,664 numbers. The net returns, on the basis of total cost, on an average, came to Rs. 3,025.76 with the lowest and highest estimates of Rs. -842.40 and Rs. 35,330.00 respectively. For the very newly established farms, the production and marketing of the species resulted in net loss.

The unit cost of production on variable cost varied from Rs. 0.48 to Rs. 1.85, with the overall mean of Rs. 0.96 (Table 15). The lower limit of mark-up was at -7.57 % and the upper limit at 99.26 %, with 30.97 % as average. The net returns ranged between Rs. 600.24 and Rs. 57,254.24 and the mean estimate was Rs. 92,269.52.

Of the 22 respondent-farmers, twenty-one produced ordinary molly. The unit cost of production varied from Rs. 0.19 to Rs. 3.20, with the mean of Rs. 1.54,

per fish (Table 14). Fishes were sold at the rate of Rs. 2.14, on an average, with the selling price ranging between Rs. 1.00 and Rs. 3.00. The highest and lowest levels of output were 2,000 and 50,000 numbers respectively, with an average yield of 11,045 numbers. The mean mark-up was 100.26 %, with the highest and lowest estimates as 102.27 % and -6.56 % respectively. The net returns varied from Rs. -2,106 to Rs. 23,555, with the mean of Rs. 5,551.66. The recently established farm in Perungudi showed a negative net returns.

On variable cost basis, the unit cost of production varied from Rs. 0.53 to Rs. 2.23, with the mean of Rs. 1.20 (Table 15). The mean mark-up was 77.24 %, with the highest and lowest estimates as 168.03 % and 34.63 % respectively. The net returns varied from Rs. 1563.75 to Rs. 38,169.50, with a mean of Rs. 2,11,573.50.

The unit cost of production for balloon molly varied from Rs. 1.02 to Rs. 5.33, with the mean of Rs. 2.46 (Table 14). Farmers sold the fish for Rs. 3.14, on an average, and the selling price ranged between Rs. 2.00 and Rs. 5.00. The average mark-up was 27.71 % varying from -6.56 % to 95.27 %. The mean level of production was 11,909 numbers with the highest production of 50,000 and the lowest production of 1,500 numbers. The net returns varied from Rs. -5,265 to Rs. 35,330, with the overall average of Rs. 9,567.73.

The mark-up ranged between 34.64 % and 152.56 %, with the mean of 60.67 % (Table 14). The unit cost of production ranged between Rs. 0.79 and Rs.3.71 and the mean was Rs.1.85. The highest and lowest net returns were Rs.57,254.24 and Rs.751.79 respectively, with the overall mean of Rs.16,534.39, on total variable cost.

Ordinary platy was produced by 16 out of 22 respondent-farmers. The average unit cost of production was Rs. 1.21 with the lowest cost of Re. 0.58 and the highest cost of Rs. 3.20 (Table 14). The fishes were sold at prices ranging between Re. 1.00 and Rs. 3.00, with an average of Rs. 1.64. The highest and the lowest mark-ups were 99.26 % and –8.52 % respectively. The peak output was 1,00,000 numbers and the trough 1,000 numbers, with the overall average of 8,386. The average net returns were Rs. 5,082.22 and inter-farm variation was of the magnitude Rs. –300.60 to Rs. 70,660.00.

The mean mark-up per fish on variable cost was 62.84 %, varying from 40.33 % to 168.03 % (Table 15). The unit cost of production ranged from Rs. 0.49 to Rs. 1.85, averaging Rs. 0.87. The mean net returns were Rs. 8,380.24, ranging from Rs. 781.87 to Rs. 1,14,504.70.

The number of producer-farmers of other platy varieties like red platy, neon platy, wag tail platy, blue platy, variegated platy and sunset platy were 17. Farmers sold the fish at the price varying from Rs. 2.00 to Rs. 6.00, with Rs. 3.30 overall (Table 14). For producing one fish, the production cost varied from Rs. 1.17 to Rs. 5.33 and the average cost worked out to Rs. 2.54. The mean mark-up was 26.93 %, the highest was 95.28 % and the lowest –6.56 %. The production level varied from 500 to 75,000 numbers, with an average of 8,409. The net returns came to Rs. 8,091.37, on an average, ranging between Rs. –3,159.00 and Rs. 88,327.50.

With the unit cost of production ranging between Rs. 0.98 and Rs. 3.18 for one fish, on variable cost, the mean was Rs. 1.90 (Table 15). The highest and

lowest net returns were Rs. 1,43,135.60 and Rs. 689.90 respectively, with the overall mean of Rs. 14,209.30. The mark-up ranged between 34.64 % and 109.15 %, with the mean of 59.89 %.

Next to ordinary molly, swordtail was produced by 86.36 % of the respondent-farmers, with the mean level of production of 10,159 numbers, ranging from 1,000 to 1,00,000 numbers (Table 14). The unit cost of production varied from Rs. 1.17 to Rs. 5.33, with the overall mean of Rs. 2.78. The lowest price was Rs. 2.00 and the highest price Rs. 6.00 and the fish was sold for Rs. 3.70, on an average. The lower limit of mark-up was at -6.56 % and the upper limit 102.27 %, with 34.56 % as average. The net returns ranged between Rs. -3,369.60 and Rs. 1,17,770.00 and the mean estimate was Rs. 10,549.74.

On total variable cost, the highest unit cost of production was Rs. 3.56 and the lowest Rs. 0.98, with the mean of Rs. 2.10 (Table 15). The mark-up percentage varied from 34.64 to 168.03, averaging 72.91. The estimated net returns averaged Rs. 18,168.25, showing variation from Rs. 1,164.80 to Rs. 1,90,847.50.

Among egg layers, gold fish ranked first in terms of production due to the conducive conditions for breeding and maintaining the fish in Madurai district. While 82 % of the farmers were producing ordinary gold, only 50 % of them were interested in producing other gold varieties like black moor, oranda gold, and bubble eyed gold. For ordinary gold, the farm gate price varied from Rs. 3.00 to Rs. 5.00, with the mean of Rs. 3.84, while other varieties, were selling at Rs. 4.91, ranging from Rs. 7.00 to Rs. 15.00 (Table 14). The average unit cost of production came to Rs. 2.91 varying from Rs. 2.36 to Rs. 5.33, for ordinary gold fish. For other gold fish, the cost of producing a single piece was little

higher, Rs. 10.67 at the most and Rs. 5.09 at the least, the average unit cost of production being Rs. 3.83. Ordinary gold fish showed the highest mark-up of 102.27 %, while for other gold fish it was only 55.28 %. The lowest mark-up for ordinary gold and other gold fish was -6.56 % and - 6.26 % respectively. The mean mark-up for ordinary gold fish and other varieties was 29.45 % and 14.50 % respectively. The level of production for ordinary gold fish varied from 2,500 to 1,50,000 numbers, with the mean of 13,777. The average production was 6,068 numbers, ranging from 1,000 to 75,000 numbers for the other varieties. The estimated net returns varied from Rs. -3,340 to Rs. 1,76,655, with the mean of Rs. 15,477.84 for ordinary gold fish. For other gold fish varieties, while the highest net returns was Rs. 1,76,647.50, the lowest net returns was Rs. -5,344.00 with the mean of Rs. 12,368.46.

For ordinary and other gold fish, on variable cost basis, the lowest unit cost of production was Rs. 1.60 and Rs. 3.92 and the highest per unit production cost estimates was Rs. 3.71 and Rs. 6.30, with the corresponding overall mean of Rs. 2.14 and Rs. 2.85 respectively (Table 15). The mean mark-up percentages for both were 68.85 and 36.39 with the lowest mark-up of 34.64 % and 40.33 % and highest mark-up of 168.03 % and 109.15 % respectively. The lowest net returns for ordinary and other gold fish were Rs. 6,431.71 and Rs. 3,194.84 and the highest being Rs. 2,86,271.20 for both of them, with the overall mean of Rs. 26,827.15 and Rs. 22,166.24, for gold fish and other gold fish respectively.

Of the 22 respondent-farmers, only seven were involved in koi production. Though there was no variation in selling price (Rs. 5.00), the unit cost of production ranged from Rs. 3.22 to Rs. 5.33, averaging Rs. 1.31 (Table 14). The mean mark-up per fish was 7.71 %, varying from -6.26 % to 55.28 %. The output

level varied from 1,000 to 80,000 numbers, with the average of 5,332. The mean net returns was Rs. 5,524.69, ranging from Rs. -1,670.72 to Rs. 94,216.00.

Blue gourami, pearl gourami, kissing gourami and golden gourami were some of the gourami varieties produced by 27 % of the respondent-farmers. The unit cost of production worked to Rs. 0.83, on an average, ranging from Rs. 1.93 to Rs. 4.45 (Table 14). The range of price was to the tune of Rs. 3.00 and the fish was sold for Rs. 1.09, on an average. As the overall average mark-up was 8.96 %, the highest and the lowest levels were 55.28 % and 18.70 % respectively. The level of output ranged from 300 to 60,000 numbers, with an average of 3,991. The net returns varied from Rs. 299.43 to Rs. 56,526.00, with the mean of Rs. 3,237.35.

In the case of fighter fish, male fighter fish was preferred over the female ones. The males had high demand as reflected in the selling price. Farmers sold the fish at a price ranging between Rs. 5.00 and Rs. 10.00, with the mean of Rs. 3.64 (Table 14). The highest unit cost of production was Rs. 8.42 and the lowest Rs. 2.20, with the mean of Rs. 2.62. The mark-up percentage varied from -6.56 to 127.48, averaging 21.68. The mean output level was 4,173, ranging from 1,000 to 50,000 numbers. The estimated net returns averaged Rs. 6,496.65, showing variation from Rs. -1,053 to Rs. 58,885.

On apportioned variable cost basis, the average unit cost of production was Rs. 2.00 with the lowest cost of Rs. 2.44 and the highest cost of Rs. 4.98 (Table 15). The highest and the lowest mark-ups were 168.03 % and 34.64 %, respectively. The average net returns were Rs. 10,525.04 and inter-farm variation was of the magnitude Rs. 1724.75 to Rs. 95,423.73.

Farmers were facing difficulties in breeding angel. The unit cost of production varied from Rs. 2.47 to Rs. 5.94, with the mean of Rs. 1.73 (Table 14). At farm level, the fishes were sold at the rate of Rs. 5.00 to Rs. 8.00, with Rs.2.27, as the mean. The mean mark-up was 14.76 %, ranging between -6.56 % and 44.84 %. The average net returns of Rs. 2,412.34 varied from Rs. -1,404.00 to Rs. 29,442.50, with production ranging between 1,000 to 25,000 numbers, averaging 2,364.

The breeding technology of oscar was known to 14 % of the farmers only. Hence, the production varied from 300 to 25,000 numbers, with the mean of 1,605 numbers (Table 14). The selling price varied from Rs. 9.00 to Rs. 10.00, with the mean of Rs. 1.32 and the unit cost of production was from Rs. 6.43 to Rs. 7.64, with the mean of Rs. 0.98. The mark-up percentages were between 18.70 and 55.28, with 4.76, as average. The net returns obtained ranged between Rs. 1,068.06 and Rs. 58,882.50, averaging Rs. 3,369.62.

Recently, cichlids had good demand in Madurai district, as the fish is colourful and attractive. In due course, the probability of all the respondent-farmers taking up this breeding of fish alone will be high. Fifty percent of the farmers were producing cichlids and selling them at prices varying from Rs. 10.00 to Rs. 15.00, with the mean of Rs. 5.41 (Table 14). The mark-up ranged between -6.56 % and 55.28 %, with the mean of 14.00 %. The average production of 5,386 numbers, lays within 1,000 to 45,000 numbers. The highest and lowest net returns were Rs. 1,05,988.50 and Rs. -10,020.00 respectively, with the overall mean of Rs. 10,491.24.

The unit cost of production for cichlids on variable cost ranged between Rs. 4.98 and Rs. 8.91, with the mean of Rs. 3.23 (Table 15). The mark-up ranged between 34.64 % and 109.15 %, averaging 34.61 %. The net returns, on an average, came to Rs. 21,795.51 with the lowest and highest estimates of Rs. 3701.48 and Rs. 1,71,762.70 respectively.

The profit margin was estimated for rosy, tiger and other barbs. The farmers sold the rosy, tiger and other barbs at rates ranging between Rs. 2.50 and Rs. 4.00, Rs. 2.00 and Rs. 3.00 and Rs. 2.50 and Rs. 3.00, averaging Rs. 1.34, Rs. 1.25 and Rs. 1.16 respectively (Table 14). For both rosy and tiger barbs, the lowest unit cost of production was Rs. 1.45, while for others, it was Rs. 1.82. The highest per unit production cost estimates for rosy, tiger and other barbs were Rs. 3.45, Rs. 2.68 and Rs. 2.29, with the corresponding overall mean of Rs. 1.06, Rs. 0.97 and Rs. 0.86 respectively. The mean mark-up percentages were 12.98, 15.50 and 14.66 for rosy, tiger and other barbs respectively. The lowest mark-up for both rosy and tiger barbs was - 6.56 %, while it was 15.92 % for other barbs. For tiger and other barbs, the highest mark-up was the same (55.29 %), but for rosy barb it was 48.05 %. The production level for rosy and tiger barbs varied from 500 to 30,000 and 25,000 numbers, with the overall mean of 2,907 and 2,486 numbers respectively. The output level range was between 1,300 and 50,000 numbers for other barbs, averaging to 4,741. The net returns for rosy, tiger and other barbs varied from Rs. -1,140.75 to Rs. 28,263.00, Rs. -737.10 to Rs. 11,777.50 and Rs. 1,005.68 to Rs. 35,330.00, with the overall mean of Rs. 1,963.73, Rs. 1,155.92 and Rs. 3,150.42 respectively.

Estimates on variable cost for rosy and tiger barbs showed the unit cost of production varying from Rs. 1.22 to Rs. 2.47 and Rs. 1.86, averaging Rs. 0.83 and Rs. 0.75 respectively (Table 15). The highest mark-up was 89.55 % and 100.70%

for rosy and tiger barb respectively. Rosy and tiger barbs showed the lowest mark-up of 34.64 %, with the mean mark-up of 28.88 % and 33.46 % respectively. The estimated net returns varied from Rs. 431.19 to Rs. 45,803.39 and from Rs. 517.42 to Rs. 19,084.75, with the mean of Rs. 3,568.18 and Rs. 2,035.20, for rosy and tiger barbs respectively.

Other ornamental fishes included pencil fish, glass fish, loach, eels, tinfoil barb and sucker fish. The selling price varied from Rs. 2.00 to Rs. 5.00, with the mean selling price of Rs. 1.84 (Table 14). The unit cost of production on an average was Rs. 1.45 and it ranged between Rs. 1.68 and Rs. 4.31. The percentage mark-up between -19.02 and 48.04 revealed a mean mark-up of 16.15 %. The level of output was 3,636 numbers overall and it varied from 250 to 10,000 numbers and the net returns showed a range of Rs. -2641.88 to Rs. 35,330.00 with Rs. 2,284.97 estimated overall.

The unit cost of production on apportioned variable cost for other varieties varied from Rs. 1.12 to Rs. 2.80, with the mean of Rs. 1.07, per fish (Table 15). The mean mark-up was 40.55 %, with the highest and lowest estimates as 168.03 % and 34.64 % respectively. The net returns varied from Rs. 590.53 to Rs. 57,254.24, with a mean of Rs. 4,029.13.

5.4 Cost function analysis

Cost function was estimated on total cost for Thoothukkudi and Madurai districts. Total variable cost function was also estimated for Madurai district.

$$1) \text{ TC} = f(Y)$$

where, TC = Total cost

and Y = Production,

$$\frac{\Delta TC}{\Delta Y} = MC_{TC}$$

$$2) TVC = f(Y)$$

where, TVC = Total variable cost

and Y = Production,

$$\frac{\Delta TVC}{\Delta Y} = MC_{TVC}$$

5.4.1 Thoothukkudi district

In Thoothukkudi district, Total cost (TC) function was estimated for all the 18 species of ornamental fish produced (Table 16). The regression co-efficients were not significant for 12 species. However, the regression co-efficients estimated for the total cost of production were positive and significant for rosy barb, other barbs, cichlids, swordtail, ordinary platy and ordinary molly at 1 % level of significance. It was significant for tiger barb at 5 % level of significance only.

The estimated function showed that the marginal costs for ordinary platy, guppy and ordinary molly were 38 %, 29 % and 23 % lower than their average prices, respectively indicating that it would be profitable to produce more of them. It was just 2 % lower than the price for swordtail. The marginal costs for all the other species were higher than the respective prices. Also, if these fish were exported, then the venture would become highly profitable and most of the producers are getting into export business for this reason. The government is also offering many incentives for exporters to encourage exports, since, the government intends to increase foreign exchange earnings many fold.

5.4.2 Madurai district

Total cost (TC) function was estimated for all the 18 species of ornamental fishes produced and marketed in the district (Table 17(a)). The regression co-efficients were mostly significant. The co-efficients estimated for the total cost of production were positive and significant for all the species except tiger barb and other varieties. The estimated function showed that the average selling price for balloon molly and ordinary molly were 46 % and 43 % higher than their marginal cost indicating that it would be profitable to step up their production to enhance farm income. In the case of ordinary gold fish, the marginal cost and the price were the same and for swordtail the marginal cost was about 5 % higher than the price. The marginal costs for all the other species were higher than the respective prices. The reasons for a similar situation found in Thoothukkudi district are applicable in Madurai district also.

Total variable cost (TVC) function was estimated for 13 ornamental fishes produced by 10-21 farms in Madurai district (Table 17(b)). The regression co-efficients were positive and significant for all the species, except fighter fish. The estimated function showed that the average selling price for balloon molly (56 %), ordinary molly (54 %), ordinary gold (19 %), sword tail (15 %), other platy (7 %), and fighter (7 %) were higher than their marginal costs indicating that it would be profitable for the farmers to increase production. For guppy, tiger barb and other varieties, the marginal cost and average selling price were more or less same and hence, the farmers could still produce them. But, the marginal cost for rosy barb (84 %), other gold (26 %), ordinary platy (13 %) and cichlids (9 %) were higher than the average selling price indicating that it would not be advisable to produce them in large quantities. However, for convenience of buyers to purchase all the fishes at one place and to attract them, the farmers may have to produce them, but in limited quantities.

The ornamental fishes, which, showed higher marginal cost than the average selling price were marked-up to 25 % and 50 %. From the analysis, it was found that the production of ordinary platy and cichlids were found to be profitable with 25 % and 50 % mark-up prices. For other gold fish, the production would be profitable, only when the price was marked-up to 50 %. Rosy barb did not show profitability on 25 % and 50 % mark-up prices (17 (c)).

5.5 Marketing channel

5.5.1 Thoothukkudi district

In Thoothukkudi district, three types of marketing channels were observed among the respondent-farmers.

Channel I : Producer / Wholesaler → Retailer → Consumer
and Producer / Retailer → Consumer

Channel II : Producer / Wholesaler → Retailer → Consumer

Channel III : Producer / Retailer → Consumer

Table 18. Marketing channel followed by the farmers – Thoothukkudi district

(*n* = 9)

Sl.No	Ornamental fish farms	Marketing channel	%
1	Institutionally based units		
	a. Medium farms	I	33.33
		II	33.33
	b. Big farms	II	11.11
2	Non-institutionally based units	III	22.22

In Thoothukkudi district, about 67 % of the medium farmers were following the first two types of marketing channels (Table 18). Non-institutionally based units (22 %) were marketing the fishes directly to the public.

5.5.2 Madurai district

The following channels were found to be observed in Madurai district.

Channel I : Producer / Wholesaler → Retailer → Consumer
and Producer / Retailer → Consumer

Channel II : Producer / Wholesaler → Retailer → Consumer

Channel III : Producer / Wholesaler / Rearer → Retailer → Consumer

Channel IV : Producer / Wholesaler / Distributor → Retailer → Consumer

In Madurai district, Channel I was observed more frequently among leased-in (13.64 %) and medium farmers (27.27 %) of non-leased in units (Table 19).

Table 19. Marketing channel followed by the farmers – Madurai district

(*n* = 22)

Sl.No	Ornamental fish farms	Marketing channel	%	
1	Leased-in units	I	13.64	
		III	4.55	
2	Non leased-in units	a. Big farms	4.55	
		b. Medium farms	I	27.27
			II	18.18
			III	4.55

		IV	9.09
	c. Small farms	II	4.55
		III	4.55
		I	4.55
		IV	4.55

5.6 CONSTRAINTS ANALYSIS

The commercial ornamental fish farming is facing several problems, which constrain its development. The constraints perceived by the respondent-farmers and retailers in both Thoothukkudi and Madurai districts are discussed below as resource constraints, production constraints, management constraints, marketing constraints and extension constraints.

5.6.1 Resource constraints

5.6.1.1 Resource constraints of the farmers and retailers – Thoothukkudi district

Among the resource constraints reported, temperature fluctuation during peak winter and summer months was reported by all the respondent-farmers (Table 20). Environmental factors that play a major role in ornamental fish farming was also included as a constraint in adverse conditions and was reported by 77.78 % of the farmers. About 44 % of the farmers were lacking sufficient farming area and water supply. The other constraints were atmospheric stress, problems in artificial fry rearing and hatching during peak winter and summer months, fluctuation in pH, when public water distribution is chlorinated, inadequate transport facility, fluctuation in salinity (ground water) and slightly high pH, which prevent the farmers to breed and maintain egg laying ornamental fishes.

Table 20. Resource constraints of the farmers

(n =

9)

Sl. No	Resource constraints	Farmers reported		Area	
		Nos.	%	in ha	%
1	Temperature fluctuation (peak winter and summer periods)	9	100	4.14	100.00
2	Environmental factors	7	77.78	4.05	97.71
3	Insufficient farm area	2	22.22	0.1	2.42
4	Inadequate water supply	2	22.22	0.1	2.29
5	Atmospheric stress	1	11.11	2.86	69.08
6	Problems in artificial rearing and hatching	1	11.11	2.86	69.08
7	Fluctuation in pH when chlorinated in public water distribution	1	11.11	0.05	1.21
8	Inadequate transport facility	1	11.11	0.5	12.08
9	Fluctuation in salinity in ground water	1	11.11	0.05	1.21
10	Problems in breeding and maintaining egg layers	1	11.11	0.5	12.08

Only one retailer reported power supply as a resource constraint. As the power supply normally shared by 6 shops, it could be a problem to the retailer, if other shops did not pay the electricity charges in time.

5.6.1.2 Resource constraints of the farmers and retailers – Madurai district

As Madurai district is rich in freshwater bodies, the resource constraints are meager, when compared to the reported farmers in the Thoothukkudi district (Table 21). Among the constraints reported, it could be seen that all the farmers had difficulties in collecting live feed. The second major constraint was non-availability of sufficient land for undertaking fish production activity (27 %). Two farms were found to be located near the reservoirs and hence, had the threat of being flooded in case the bunds breached. The abundant wild ornamental fish resources available in Tamil Nadu are yet to be exploited and it was also considered as a resource constraint by about 5 % of the farmers (about 25 % of farm area).

Table 21. Resource constraints of the farmers

(n = 22)

Sl No	Resource constraints	Farmers reported		Area	
		Nos.	%	in ha	%
1	Collection of live feed in far areas	22	100.00	7.77	100.00
2	Insufficient farm area	6	27.27	0.35	4.50
3	Flood	2	9.09	3.40	43.76
4	Non exploitation of wild resource	1	4.55	2.00	25.74

Since, Madurai is a city, corporation heavily charges the roadside shops in busy areas i.e. the shop-keepers (small shops) have to pay an advance of about Rs. 50,000 and a monthly rent of about Rs. 1,000 (varies with the area and location of the shop). Hence, they were unable to expand their business.

5.6.2 Production constraints

5.6.2.1 Production constraints faced by the farmers and retailers – Thoothukkudi district

The production constraints reported by the Thoothukkudi ornamental respondent-farmers are presented in Table 22(a). On one hand, this is considered as a lucrative farming practice. But, on the other hand, it is highly risky because of high mortality. Usually, fishes died during transport. About 44 % of the respondent-farmers reported non-availability of credit and labour problems as major constraints. Absence of technically skilled personnel, absence of research in private farms, absence of facilities for genetic improvement, non-availability of brood fish resource and absence of government and legal support were the other production constraints reported by them.

Table 22(a). Production constraints of the farmers

(n = 9)

Sl. No	Production constraints	Farmers reported		Area	
		Nos.	%	in ha	%
1	Disease outbreak	9	100.00	4.14	100.00
2	Mortality	9	100.00	4.14	100.00
3	Washing out of fishes during transport	2	22.22	3.36	81.16
4	Non-availability of credit	2	22.22	0.55	13.29
5	Labour problem	2	22.22	0.55	13.29
6	Absence of technically skilled personnel	1	11.11	2.86	69.08
7	Absence of research in private farms	1	11.11	2.86	69.08
8	Non-availability of license for importing brooders	1	11.11	2.86	69.08
9	Lack of brood fish resource	1	11.11	2.86	69.08
10	Absence of facilities for genetic improvement	1	11.11	2.86	69.08
11	Absence of government and legal support	1	11.11	2.86	69.08

Table 22(b) shows the number and percentage of the retailers reporting production constraints. Disease outbreak and mortality during transport were the major constraints faced by the retailers as reported by 100 % of the retailers. Other production constraints include low survival rate, mortality during peak winter and summer periods and labour problems.

Table 22(b). Production constraints of the retailers

Sl. No	Production constraints	Retailers reported	
		Nos	%
1	Disease outbreak	9	100.00
2	Mortality during transport	9	100.00
3	Less survival rate	1	11.11
4	Mortality (peak winter & summer periods)	1	11.11
5	Labour problem	1	11.11

5.6.2.2 Production constraints faced by the farmers and retailers – Madurai district

Table 23(a). Production constraints of the respondent farmers

(n = 22)

Sl. No	Production constraints	Farmers reported		Area	
		Nos.	%	in ha	%
1	Disease outbreak	22	100.00	7.77	100.00
2	Mortality (peak winter & summer periods)	22	100.00	7.77	100.00
3	Environmental stress	22	100.00	7.77	100.00
4	Non-availability of credit	8	36.36	0.86	11.07
5	Absence of government and legal support	5	22.73	5.73	73.75
6	Non-availability of license for importing brooders	2	9.09	3.40	43.76
7	Risks in breeding and maintaining egg layers	2	9.09	0.06	0.77

All the farmers reported disease outbreak, mortality during peak winter and summer months and environmental stress as major production constraints in their farms (Table 23(a)). Non-availability of credit, another constraint was reported by about 36 % of them. The other constraints were absence of government and legal support, non-availability of license for importing brooder fish and risks in breeding egg layers.

Table 23(b) presents the production constraints of the respondent-retailers in Madurai district. Disease outbreak and mortality were the major constraints reported by them. About 10 % of the retailers ranked lack of investment as the second major production constraint.

Table 23(b). Production constraints of the retailers

(*n* = 10)

Sl. No.	Production constraints	Retailers reported	
		Nos.	%
1	Disease outbreak	10	100.00
2	Mortality during transport	10	100.00
3	Lack of investment	1	10.00

5.6.3 Management constraints

5.6.3.1 Management constraints faced by the farmers and retailers – Thoothukkudi district

About 22 % of the respondent-farmers reported pilfering as a major management constraint (Table 24). Social problems and improper guidance were considered as other management constraints by another 22 % of them.

Table 24. Management constraints of the farmers

Sl. No	Management constraints	Farmers reported		Area	
		Nos.	%	ha	%
1	Pilfering	2	22.22	0.11	2.66
2	Social problems	1	11.11	0.05	1.21
3	Improper guidance	1	11.11	0.5	12.08

Only one management constraint was reported by the respondent-retailers. As the retailers had other occupations, they could not pay adequate attention in developing ornamental fish trade.

5.6.3.2 Management constraints faced by the farmers– Madurai district

Predation of ornamental fishes in the farm by birds was reported as the management constraint by a farmer.

5.6.4 Marketing constraints

5.6.4.1 Marketing constraints of the retailers – Thoothukkudi district

The marketing constraints reported by the respondent-retailers are given in Table 25. Location of the shops in interior areas and less busy areas were the major marketing constraints reported by them.

Table 25. Marketing constraints of the retailers

(n = 10)

Sl.No	Marketing constraints	Retailer reported	
		Nos.	%
1	Location in interior areas	1	11.11
2	Location in less busy areas	1	11.11

5.6.4.2 Marketing constraints faced by the farmers and retailers – Madurai district

Table 26(a) shows the number and percentage of the respondent-farmers reporting constraints. Location of farms in outer areas (13.64 %) was the major marketing constraint for the farmers. Tough competition, absence of local government market and particular organization for the development of ornamental fish industry were reported as the other marketing constraints by the farmers.

Table 26(a). Marketing constraints of the respondent farmers

(n = 22)

Sl. No	Marketing constraints	Farmers reported		Area	
		Nos.	%	in ha	%
1	Location in outer areas	3	13.64	3.06	39.38
2	Tough competition	2	9.09	0.11	1.42
3	Absence of government market locally	1	4.55	2.00	25.74
4	Absence of organization for development	1	4.55	2.00	25.74

Table 26(b). Marketing constraints of the retailers

(n = 10)

Sl.No	Marketing constraints	Retailers reported	
		Nos.	%
1	Tough competition	1	10
2	Location in interior areas	1	10

Tough competition and location of the shops in interior areas were reported as marketing constraints by about 20 % of the respondent-retailers in Madurai district (Table 26(b)).

5.6.5 Extension constraints

Absence of adequate knowledge on ornamental fish farming and business was the only extension constraint reported by the respondent farmers in Thoothukkudi and Madurai districts.

Chapter – 6

SUMMARY AND CONCLUSION

An economic analysis of aquaculture (ornamental fish culture) was carried out by applying alternative costing techniques and the price for various products in ornamental fish farms in Thoothukkudi and Madurai districts were estimated. The specific objectives of the study were to estimate the unit cost of production of selected ornamental fishes applying alternative methods of costing, to price the selected ornamental fishes by cost-plus method, to compare the estimated prices with the actual selling prices, to estimate a cost function on the bases of total cost and variable cost, to investigate the marketing of aquarium fishes, to identify the constraints to aquaculture and to identify suggestions for development.

Thoothukkudi, a maritime district and Madurai, an inland district, were selected for the study considering the different agro-climatic conditions. Thoothukkudi has marine fisheries endowments like pearl and chank fisheries. Madurai, on the otherhand, offers a huge market potential for food and aquarium fishes.

The required data were collected from over 95 % of the ornamental fish farmers and over 85 % of the retailers, who trade in aquarium fishes. Additional information on the status of aquaculture and trade was also collected from technical experts, officials of the MPEDA, State Fisheries Department and Banks. Results of the analysis of the data are briefly summarized below.

6.1 General characteristics

In Thoothukkudi district, 44 % of the respondent farmers were within 31-35 years of age and 78 % of the retailers were aged over 40 years. About 67 % of the farmers had 1-10 years of experience in aquariculture and 44 % of the retailers had 6-10 years of experience in ornamental fish trade. The literacy level for both the farmers (78 %) and retailers (67 %) was up to college degree level. While, 44 % of the farmers had ornamental fish culture as their primary occupation, 78 % of the retailers were undertaking ornamental fish trade as their primary occupation. The farms were categorized into institutionally based (22 %) and non-institutionally based units (78 %) covering a total area of 4.14 ha.

In Madurai district, about 46 % of the respondent farmers were aged above 40 years and only 10 % of the retailers were in the 36-40 age class. The farmers (55 %) had 6-15 years of experience in aquariculture. About 50% of the retailers were engaged in ornamental fish trade with five years of experience. All the farmers and retailers were literates. While 86 % of the farmers had aquariculture as their primary occupation, 90 % of the retailers had ornamental fish trade as their primary occupation. The selected farms (7.765 ha) were classified into leased-in (0.37 ha) and non-leased in (7.395 ha) farm units.

6.2 Economics of aquariculture

Total cost of aquariculture in Thoothukkudi district was estimated as Rs. 30,75,820 of which total variable cost and total fixed cost accounted for Rs. 20,51,708 and Rs. 10,24,112 respectively. Among the variable cost items, wages (30 %) and feed (26 %) were the major ones. Among the fixed cost items, interest on capital cost formed the major share (39 %), followed by depreciation (33 %), while rent on land/lease value for ponds and tanks (7 %) had the least share. About 22 % of the farmers realized net returns up to Rs. 16,580, and about 66 % of them obtained net returns ranging from Rs. 1,04,200 to Rs. 4,47,690. The

cost benefit ratio was 1.35 and 2.03 on total cost and total variable cost bases respectively.

In Madurai district, the total variable cost of Rs. 68,42,934 and total fixed cost of Rs. 18,78,496 constituted total cost of Rs. 87,21,430. Wages (33 %) and feed (20 %) took the major share among the variable cost items. Among the fixed cost items, interest on capital cost (36 %) and depreciation (28 %) were the major ones. The average total returns and net returns were Rs. 5,04,659 and Rs. 1,08,230 respectively. The cost benefit ratio on total cost and total variable cost were 1.27 and 1.62 respectively.

6.3 Cost-plus pricing of ornamental fish production

Apportioned total cost and variable cost were used for computing mark-up and net returns for ornamental fishes produced in Thoothukkudi and Madurai districts.

In Thoothukkudi district, profit margin was estimated for seventeen ornamental fishes on apportioned total cost basis. It was found that the mean unit cost of production was high for cichlids (Rs. 5.13) and low for oscar (Rs. 0.43). For oscar, the average selling price was low (Rs. 0.56) and high for cichlids (Rs.7.56). The highest and lowest mean mark-up percentages were 37.98 and 3.23 for ordinary molly and oscar respectively. Among all species produced, the highest average production was 16667 numbers for angelfish, while the lowest was 278 numbers for gourami fish. The mean net returns obtained for gourami was noticed to be low (Rs. 581.63) and high (Rs. 23,966.10) for cichlids.

The estimation on apportioned total cost was carried out in Madurai district for eighteen ornamental fishes. While the lowest mean selling price was Rs. 1.09 for gourami, the highest was Rs. 5.41 for cichlids, with the average maximum and minimum unit cost of production of Rs. 4.33 and Rs. 0.83, for cichlids and

gourami, respectively. The lowest mean production and mark-up were for oscar which accounted for 1,605 numbers and 4.76 % respectively. The highest average production of ordinary gold fish was 13,777 numbers, with net returns of Rs. 15,477.84. The highest mean mark-up (100.26 %) was observed for ordinary molly. Tiger barb realized the lowest average net returns (Rs. 1,155.92).

On apportioned total variable cost basis, the lowest and highest estimates of average cost of production and selling price of per fish were Rs. 0.75 for tiger barb and Rs. 3.23 and Rs. 5.41 for cichlids, respectively. Rosy barb showed the lowest mean mark-up percentage of 28.88, while ordinary molly had the highest mean mark-up of 77.24 %. The minimum average production and net returns were recorded for tiger barb, 2,486 numbers and Rs. 2,035.20 respectively. The net returns and production were maximum, with the mean of Rs. 2,11,573.50 and 13,777 numbers for ordinary molly and ordinary gold fish respectively.

6.4 Cost function

On total cost basis, cost function was estimated for Thoothukkudi and Madurai districts. Total variable cost function was also estimated for Madurai district where apportioned cost (total cost and total variable cost) is considered as a function of production (Y).

The estimated total cost function in Thoothukkudi district revealed that the marginal cost were 38 %, 29 % and 23 % lower than their average selling prices for ordinary platy, guppy and ordinary molly respectively, indicating the profitability in producing them more. But, for all other species, the condition was reverse.

In Madurai district, total cost function was estimated for eighteen ornamental fishes. It was found that the production of balloon molly and ordinary molly could be stepped up to enhance profitability as the average selling price

were 46 % and 43 % higher than their marginal cost. While the marginal cost was higher than the price for all other fishes, the marginal cost and price were same for ordinary gold fish.

Total variable cost function was estimated for 13 ornamental fishes produced by 10-21 farms in Madurai district. The estimated function showed that it would be profitable to increase the production of balloon molly, ordinary molly, ordinary gold, sword tail, other platy and fighter as average selling prices were 56 %, 54 %, 19 %, 15 %, 7 %, and 7 % higher than their marginal cost respectively. Also, it would be advisable not to produce ordinary platy, other gold, cichlids and rosy barb in large quantities since their marginal cost is on the higher side. For guppy, tiger barb and other varieties, the farmers could produce them still because their price and marginal costs were more or less the same. The ornamental fishes which showed higher marginal cost were marked-up to 25 % and 50 %. It would be profitable to produce ordinary platy and cichlids, if the price was marked-up to 25 % and 50 %.

6.5 Marketing channel

The different marketing channels followed by fish farmers were investigated in both the districts. It has been found that Channel I (Producer / Wholesaler → Retailer → Consumer and Producer / Retailer → Consumer) was widely followed by medium farmers of both Thoothukkudi (33 %) and Madurai (27 %) districts.

6.6 Constraints

The constraints faced by the farmers and retailers in Thoothukkudi and Madurai districts were discussed under resource constraints, production constraints, management constraints, marketing constraints and extension constraints.

6.6.1 Resource constraints

Among the ten resource constraints reported by the respondent-farmers in Thoothukkudi district, temperature fluctuation during peak winter and summer periods and environmental factors in adverse conditions were considered as major resource constraints.

In Madurai district, collection of live feed in distant areas was reported as major resource constraint by the farmers followed by non-availability of sufficient land for undertaking farming activity.

6.6.2 Production constraints

Mortality and disease outbreak were found to be the major production constraints faced by both farmers and retailers of Thoothukkudi and Madurai districts. The other production constraints included non – availability of credit and license for importing brooders.

6.6.3 Management constraints

Pilfering, social problems and improper guidance were reported as primary management constraints by Thoothukkudi farmers.

6.6.4 Marketing constraints

The major marketing constraint reported by the retailers of Thoothukkudi district was location of shops in interior and less busy areas.

About 14 % of the farmers in Madurai district reported that non-accessibility to farms was the major marketing constraint faced by them. The retailers in Madurai district reported location of shops in interior areas and prevailing tough competition as marketing constraints.

6.6.5 Extension constraints

Absence of adequate knowledge on aquariculture was the extension constraint faced by the farmers in both Thoothukkudi and Madurai districts.

6.7 Policy suggestions

1. Fish pathology laboratories need to be set up atleast in major breeding centres to overcome possible disease outbreaks. Mobile fish health centres with qualified professionals could be pressed into service to the farmers, who are in need.
2. The State Government may come forward to encourage aquarists and interested entrepreneurs to take up farming of highly priced aquarium fishes by extending easy credit facilities and subsidy through bank and other financial institutions.
3. Aquariculture industry needs to be provided with similar facilities and concessions as given to the agriculture sector. If possible co-operatives and Self Help Groups (SHG's) could be formed to facilitate production and marketing of ornamental fishes.
4. Licence should be provided to the farmers for importing exotic brood fishes to develop different strains to meet the demand for such fishes in international market.
5. Awareness campaigns have to be launched to educate the people on the usefulness of undertaking aquariculture and maintaining different kinds of ornamental fishes.

6. Training programmes need to be conducted on different aspects of aquaculture for short and long durations depending on the requirements of the clientele groups.
7. More techno-economic studies may be taken up by Fisheries Research Institutes.
8. Farmers may be encouraged to include supplementary enterprises; eg. Spirulina, algal culture.
9. Regular follow up extension service may be provided.
10. Application of econometric methods of cost studies like Linear Programming for cost optimization may be taken up.
11. Export promotion programmes may be introduced through Marine Products Export Development Authority (MPEDA).
12. The hobby of aquarium keeping may be popularized through mass media to motivate the people to take up aquaculture practice commercially.

Chapter 7

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