Research Article

ECONOMIC ANALYSIS OF AQUACULTURE IN NELLORE DISTRICT, ANDHRA PRADESH

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Abstract: For the success of India's economic reforms, foreign trade has a pivotal role to play in the economic growth. Aquaculture, also referred to as ornamental fish culture is a promising alternative for employment and income generation in domestic and export markets. The study was taken up to analyze the economics of Aquaculture by applying alternative costing techniques such as cost-plus method in Nellore district during the period 2018-2019. The results revealed that about 44% of the farmers had Aquaculture as their primary occupation and the estimated total cost was Rs. 30,76,920 of which total variable cost and total fixed cost accounted for 67% and 33%, respectively. The benefit cost ratio on total cost and total variable cost bases were 1.35 and 2.03, respectively, indicating the profitability of the venture. While the mean mark-up by cost- plus method was the highest for Guppy, ordinary molly and sword tail (37.98%), net return was the highest for Cichlids (Rs. 23966.16). The estimated total cost function showed that the marginal costs were 38%, 29% and 23% lower than their average selling price for ordinary platy, guppy and ordinary molly, respectively, indicating the profitability in producing them more.

Keywords: Aquaculture, Economics, Cost-plus pricing, Cost function analysis

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Introduction

The changing global socio-economic scenario 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 [1]. The world trade of ornamental fish has been estimated to be around Rs. 20,700 crores in 1995 and was making further strides, with 10% annual growth [2]. About 85% of the global trade was based on freshwater ornamental fishes and the rest by marine fishes. 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 [3]. The major production hubs were primarily concentrated in South-East Asia [4]. 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. Dey and Tomey [5] discussed the importance of ornamental fishes in increasing our exports and on the resource potential of freshwater, brackish water and marine ornamental fishes. The demand for ornamental fish in the domestic market outstrips its supply thus indicating the large scope available for the production of ornamental fish.

Many entrepreneurs hesitate to invest in this trade in need of information on the cost involved, expected income, breeding techniques, constraints, assistance development, etc. This study addresses the major lacuna of lacking information on the economics of production and marketing of ornamental fish. In view of this, the study was undertaken 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 and to estimate a cost function on the bases of total cost and variable cost.

Materials and Methods

Nellore district was purposively chosen for the study considering the emerging importance of Aquaculture in the district. Neither the government nor any private organization has documented complete information on the Aquaculture farms, the required data were collected from almost all the operational farms (9 farms) in and around Nellore by adopting random sampling technique from May 2018 to April 2019. The farms were located at Inamadugu, Mypadu, Nellore North, Koduru and Iskapalli. Based on the objectives of the study, the information was collected through pre-tested survey scheduleand personal interviews. Additional information on the status of Aquaculture and trade was collected from technical experts, officials of the MPEDA and State Fisheries Department.

Tools of Analysis

Owing to the constraints imposed by the behavior of data, tabular and percentage analyses of costs and returns was made to estimate the economics of Aquaculture in Ms Excel. The technique of ascertaining cost is known as "Costing" and cost ascertainment is the primary objective of cost accounting [6]. In the present study, costs were ascertained using the costing principles such as fixed cost, variable cost, total cost and unit cost of production, all including apportionment of joint costs and opportunity costs. The ornamental fishes of commercial value and high reach in domestic markets were considered for analysis. For each species, apportioned total cost was used for computing mark-up and net returns for all fishes produced in the study area. The percentage of profit on the average actual selling price was considered as mark-up. The economics of each species based on the actual mark-up was considered for discussion. Total cost function was estimated using regression analysis to estimate the marginal cost of the variables and to know the relationship between the costs and production.

Results and discussion
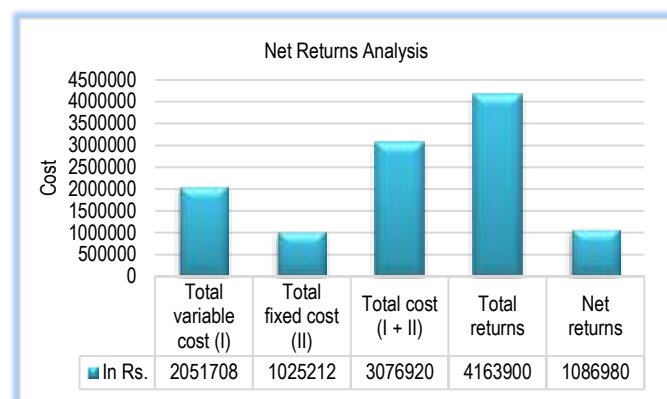## General Characteristics

In Nellore district, the surveyed farms were categorized into institutionally based (22%) and non-institutionally based units (78%) covering a total area of 4.14 ha [Table-1]. About 44% of the farmers were within 31-35 years old and about 67% of them had 1-10 years of experience in Aquaculture [Table-2]. Majority of the farmers had literacy level up to college level (78%) and about 44% of the farmers had Aquaculture as their primary occupation [Table-3].

Table-1 *Classification of farms*

Area in ha	Number of ornamental fish farms	Total area (ha)
1. Institutionally - based units		
a. up to 0.5	2 (22.22)	0.075
b. above 0.5	-- (0)	--
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

Economics of Aquaculture

The economics of Aquaculture was estimated as presented in [Table-4]. Felix[7] estimated the economics of a small-scale Aquaculture unit and highlighted the importance of ornamental fishes for export and identified the reasons for adequate development of Aquaculture in India. The estimated total cost in Aquaculture was Rs. 30,76,920 of which total variable cost and total fixed cost accounted for 67% and 33%, respectively. The total variable cost was Rs. 20,51,708 consisting of wages (30%), feed (26%), brood stock (16%), power (11%), interest on variable cost (7%), others (7%) and oxygen packing (3%). The total fixed cost (Rs.10,25,212) includes interest on capital cost (39%), depreciation (33%), repairs and maintenance (19%) and rent (9%). 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 [1]. In the study, while the total and net returns were Rs. 41,63,900 and Rs. 10,86,980, respectively, the mean net returns were accounted as Rs. 1,20,898. The cost benefit ratio on total cost and total variable cost bases were 1.35 and 2.03, which indicated that the Aquaculture business was a profitable enterprise.

Variable Cost/Year(rs.2051708)

- a. Feed — 26%
- b. Oxygen packing — 3%
- c. Brood stock — 16%
- d. Wages — 30%
- e. Power — 11%
- f. Interest on variable cost — 7%
- g. Others — 7%

Fixed Cost/Year(rs.1025212)

- a. Depreciation — 33%
- b. Interest on capital cost — 39%
- c. Rent — 9%
- d. Repairs and maintenance — 19%

Net Returns Analysis

	Total variable cost (I)	Total fixed cost (II)	Total cost (I + II)	Total returns	Net returns
In Rs.	2051708	1025212	3076920	4163900	1086980

Cost-plus Pricing of Aquaculture

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 area. For computing mark-up and net returns, apportioned Total Cost (TC) was used for all the ornamental fishes under the purview of the investigation [Table-5].

The results revealed that the mean unit cost and mean selling price were highest for Cichlid (Rs.5.13 and Rs. 7.56) and the lowest for Oscar (Rs. 0.43 and Rs. 0.56). The mean mark-up by cost- plus method was the highest for Guppy, ordinary molly and sword tail (37.98%) and thelowest estimates was for Oscar (3.23). The highest and lowest average yields were 25,322 (Fighter) and278 numbers (Gourami), respectively. The net returns on the basis of total cost varied from Rs. 23,966.16 for Cichlids and Rs. 581.63 for Gourami.

Cost Function Analysis

Total Cost (TC) function was estimated for the ornamental fishes as listed in [Table-6]. The regression coefficients were not significant for 12 species. However, the regression coefficients 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 total cost function showed that the marginal costs 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. It was just 2% lower than the price for swordtail. But, the marginal costs for all other species were higher than the respective selling prices. The ornamental fishes of freshwater and marine origin fetched Rs.8 -10 per kg (100-200 nos.) in the domestic market, while their export value was 20 times more, indicating huge loss in foreign exchange [8]. The study revealed that if the ornamental fishes 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 extending financial assistance through various promotional schemes to encourage exports many folds.

Conclusion

Aquaculture is an emerging sector in Nellore district. From the study, it has been concluded that, Cichlids, Angel (*Pterophyllum scalare*) Fighter (*Betta splendens*), Balloon molly (*Poecilia sphenops*), Ordinary platy (*Xiphophorus maculatus*), Guppy (*Poecilia reticulata*) and Ordinary molly (*Poecilia* sp.) could be produced in large quantities against other varieties as their average selling price and mean net returns were on higher side indicating more profits.

Hence, this venture could be taken up by the unemployed youths and women as backyard unit with the above-mentioned ornamental fish varieties as an alternate livelihood option due to the nature of profitability and huge domestic market potential. Since this business provides vast scope for development of export trade, the necessary assistance on commercial Aquaculture technology with adequate investment, technical know-how and managerial skills could be provided by government supported programmes to fetch more foreign exchange.
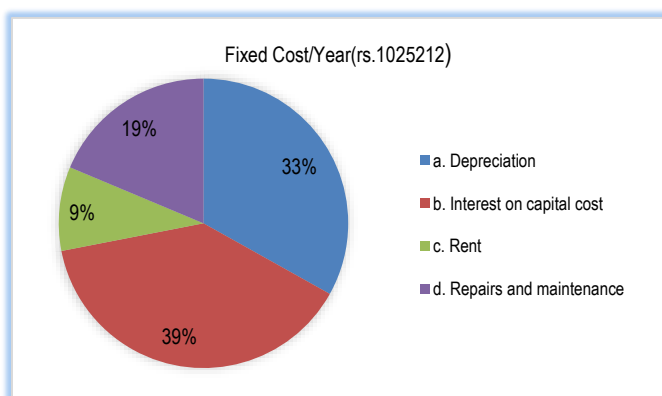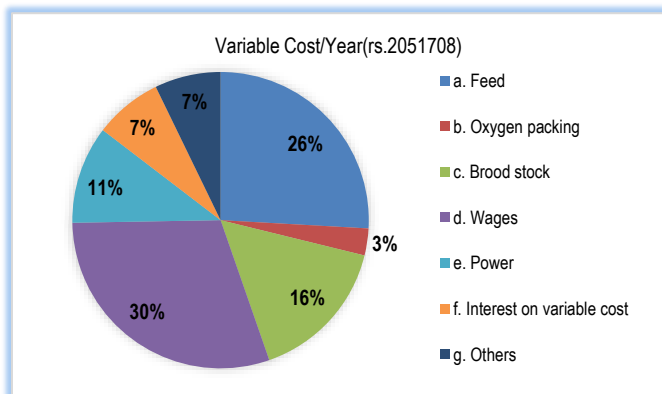
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Table-2 *Age and experience of the farmers (n = 9 farms)*

Age class in years	Number of farmers reported	Experience in years	Number of farmers reported	
			Ornamental fish culture	Allied activities
Below 20	0	0 – 5	3(33.33)	4(50)
21– 25	1 (11.11)	6 – 10	3(33.33)	2(25)
26 – 30	1 (11.11)	11 – 15	1(11.11)	--(0)
31 – 35	4 (44.44)	Above 15	2(22.22)	2(25)
36 – 40	1 (11.11)	--	--	--
Above 40	2 (22.22)	--	--	--

Table-3 *Educational and occupational status of the farmers (n = 9 farms)*

Education	Number of farmers reported	Occupation	Number of farmers reported	
			Primary	Secondary
Primary school	0	Ornamental fish culture	4(44.44)	5(55.55)
Secondary school	0	Others	4(44.44)	4(44.44)
Higher secondary school	2 (22.22)	Agriculture	1(11.11)	--(0)
College	7 (77.77)	Business	0	
Total literate	9 (99.99)	--	--	--
Illiterate	--	--	--	--

Table-4 *Economics of Aquaculture in sample farms*

Particulars	Cost (Rs./year)	Cost bifurcation (%)	% to total cost
I. Variable cost			
a. Feed	531220	26.00	17.26
b. Oxygen packing	60300	3.00	1.96
c. Brood stock	325000	16.00	10.56
d. Wages	616500	30.00	20.04
e. Power	219000	11.00	7.12
f. Interest on variable cost	151988	7.00	4.94
g. Others	147700	7.00	4.80
Total variable cost (I)	2051708	100.00	66.67
II. Fixed Cost			
a. Depreciation	339464	33.00	11.03
b. Interest on capital cost	398048	39.00	12.94
c. Rent	96250	9.00	3.13
d. Repairs and maintenance	191450	19.00	6.22
Total fixed cost (II)	1025212	100.00	33.32
Total cost (I + II)	3076920	--	100.00
Total returns	4163900	--	--
Net returns	1086980	--	--
BCR (TC)	1.35	--	--
BCR (TVC)	2.03	--	--

(Rs.-Rupees, BCR-Benefit Cost Ratio, TC-Total Cost, TVC-Total Variable Cost)

Table-5 *Profit margin for ornamental fishes in Nellore district (TC)*

SN	Ornamental fishes	Common name	Mean unit cost (Rs.)	Mean selling price (Rs.)	Mean % Markup	Mean production in numbers	Mean net returns (Rs.)
1	*Poecilia reticulata*	Guppy	1.47	2.06	37.98	4500	3695.96
2	*Poecilia* sp.	Ordinary molly	1.34	1.83	37.98	4778	2716.69
3	*Poecilia sphenops*	Balloon molly	1.70	2.50	33.25	11389	18987.45
4	*Xiphophorus maculatus*	Ordinary platy	1.24	1.67	30.01	3478	2412.8
5	*Xiphophorus* sp.	Platy sp.	1.87	2.78	33.25	7556	10880.92
6	*Xiphophorus hellerii*	Swordtail	2.03	3.00	37.98	3333	4122.09
7	*Carassius auratus*	Ordinary gold	2.42	4.00	25.82	2150	9231.86
8	*Carassius* sp.	Gold sp.	2.00	3.33	15.27	500	3064.53
9	*Cyprinus carpio var koi*	Koi	1.59	2.00	8.81	2389	1465.47
10	*Osphronemus goramy*	Gourami	0.59	1.00	15.27	278	581.63
11	*Betta splendens*	Fighter	3.72	5.56	35.68	25322	19564.79
12	*Pterophyllum scalare*	Angel	0.68	1.00	10.74	16667	18733.2
13	*Astronotus ocellatus*	Oscar	0.43	0.56	3.23	5556	6255.58
14	Cichlids	Cichlids	5.13	7.56	36.48	10833	23966.1
15	*Pethia conchonius*	Rosy barb	0.64	1.06	36.97	2222	1012.78
16	*Puntigrus tetrazona*	Tiger barb	0.76	1.06	27.28	2278	801.66
17	*Barbus* sp.	Barbs sp.	0.57	0.89	26.47	2333	1219.48

(Rs.-Rupees, TC-Total cost)

Application of research: To assess the Ornamental Fish Culture in Nellore District, Andhra Pradesh, India

Research Category: Fisheries Economics, Cost Function analysis in Aquaculture

**Principal Investigator or Chairperson of research: Prof. R Jayaraman
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Research project name or number: General Survey and case study
Author Contributions: All authors equally contributed
Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Table-6 Total cost function for Aquaculture in Nellore district

Ornamental fishes	R^2	No of Farms	Intercept	Standard error	Coefficient	Standard error	Selling Price (Rs.)
Poecilia reticulata	0.84	7	1835.41	2132.81	1.47	0.29	2.06
Poecilia sp.	0.74	7	1679.02	2789.44	1.41*	0.37	1.83
Poecilia sphenops	0.09	5	47401.28	23249.23	-0.52	0.94	2.50
Xiphophorus maculatus	0.87	6	2233.99	1481.54	1.04*	0.20	1.67
Xiphophorus sp.	0.6	5	4632.81	22433.21	3.02	1.42	2.78
Xiphophorus hellerii	0.75	7	-13139.8	3402.40	2.95*	0.77	3.00
Carassius auratus	0.77	4	-4565.40	14828.15	6.92	2.64	4.00
Carassius sp.	1	2	14915.83	0	2.24	0	3.33
Cyprinus carpiovar Koi	0.91	3	1095.10	11353.08	4.43	1.38	2.00
Osphronemus goramy	1	2	-99.63	0	2.79	0	1.00
Betta splendens	0.74	7	11889.26	8225.43	0.41	0.11	5.56
Pterophyllum scalare	1	2	-4637.82	0	3.13	0	1.00
Cichlids	1	6	-4641.07	8471.43	9.54*	0.32	7.56
Pethia conchonius	1	5	-146.959	235.33	1.17*	0.03	1.06
Puntigrus tetrazona	0.81	5	390.327	1840.01	1.25**	0.35	1.06
Barbus sp.	1	4	-544.95	146.13	1.58*	0.02	0.89

* Significant at 1 % level of confidence ** Significant at 5 % level of confidence

Study area / Sample Collection: Nellore District, Andhra Pradesh, India

Cultivar / Variety / Breed name: Guppy, Ordinary molly, Swordtail, Cichlids

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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