Turkish Journal of Fisheries and Aquatic Sciences 4: 33-38 (2004)

Cost Analysis in Gilthead Sea Bream (*Sparus aurata* Linnaeus, 1758) and Sea Bass (*Dicentrarchus labrax* Linnaeus, 1758) Production in Milas District-Muğla Province, Turkey

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Received 21 September 2004
Accepted 27 December 2004

Abstract

The purpose of this research was to calculate the per-kilogram production cost of Gilthead Sea Bream and Sea Bass by structural and economic analysis of Gilthead Sea Bream/Sea Bass Farms in the Milas District of Muğla Province. All of the 24 farms engaged in Gilthead Sea Bream and Sea Bass production in the research were covered, and data collected from these farms through interviews and questionnaires were analysed. Total production costs consist of 95% variable costs and 5% fixed costs. In total, 44,500 kg of Gilthead Sea Bream and 34,400 kg of Sea Bass are produced on average annually on these farms, and the per-unit cost of Gilthead Sea Bream is calculated to be $ 2.48/kg, and for Sea Bass, this figure is calculated to be $ 2.34/kg.

Key Words: Gilthead sea bream, Sea Bass, production costs, unit cost of product, Turkey

Introduction

Nutritional sufficiency and balance are the most significant determining factors for the survival of a healthy and robust life for society for the individual members in it.

Turkey can be described as being simultaneously faced with the problems of both developing and developed countries, from the perspective of diet. The Turkish diet exhibits significant variation depending on geographic region, season of year, socioeconomic condition, and distribution of urban-rural settlement. This variation in diet arises from uneven economic distribution.

Research has shown that, in a balanced diet, 60% of the total daily protein requirement should come from plant sources, while the other 40% should come from animal sources (Erkuş *et al*., 1995; Özkan, 1993). According to FAO statistics, the daily total protein requirement comes 63% from plant crops and 37% from animal products worldwide. These figures are 44% and 56% in developed countries, 70% and 30% in developing countries, and 74% and 26% in Turkey, respectively. As for animal-derived protein in particular, 15% worldwide, 12% in developed countries, 18% in developing countries, and 9% in Turkey come from fishery products (Anonymous, 2003).

Current levels of livestock production are insufficient to meet demand in Turkey. Fishery products possess superior nutritional characteristics, such as protein, energy, mineral, and vitamin content, and ease of digestibility. Fish constitute an important food resource and would go a long way in providing missing animal protein. Fishery products, primarily fish, have an important place in human nutrition as a source of animal protein.

Despite its great potential, the fishery sector has not been able to assume the place it deserves either in the farming sector or in the national economy of Turkey, the bulk of whose land mass is a peninsula that is surrounded by sea on three sides and that possesses rich inland water resources.

Increasing the production of fishery products for the provision of missing animal protein is an important issue in improving technology and production processes. Marine fisheries account for 78.2% of total national fish production, artificial (cultured) fish for 11.3%, inland fish production for 7.3%, and other marine products make up 3.2% of total fish output in Turkey.

Per-capita fish consumption is 8.3 kg/year in Turkey. Fishery product consumption per capita is 15 kg/year in the world, 23 kg/year in EU countries and 25.1 kg/year in neighbouring Greece. Turkey's fishery product consumption rate should rise to the worldwide average. In this context, vigorous support and encouragement should be provided for research and development activities that promote the rational use of fishery products and resources.

Gilthead sea bream and sea bass account for 42.36% of total national fish production in Turkey. Fish production makes a valuable and important contribution to the economy, creates employment opportunities, and provides a quality food source for society. Several measures should be taken towards further development of this sector of the economy, such as balancing supply and demand in a stable manner, conducting research on the nation's financial and economic structure in order to adjust the financial structure of fish farms, and to identify and find solutions to existing problems in the sector.

Few economic studies or financial analyses on fisheries have been conducted so far. Socio-economic studies carried out to determine the problems and the general structure of the sector constitutes a significant source of information to the operations managers and provides needed data on the development of the sector. Besides, such research also helps to develop individual activities of operations.

Earlier research in this field has attempted to find out the structural, technical and economic conditions concomitant with gilthead sea bream and sea bass production. It has been determined that feed costs account for the bulk of operating costs, which is added to the cost of labour and of purchasing young fish and then divided by the number of units to calculate the cost per unit of crop. (Çokyüce, 1993; İşgören, 1996; Şası, 1996; Demir, 1997; Gier, 1998; Rad, 1999).

This study was carried out in Milas district of the province of Muğla, where Gilthead sea bream and sea bass production are widespread and where the per-kilogram cost of each kind of fish can be calculated separately by determining the current structure, capital, and the cost of the implements of production for Gilthead sea bream and sea bass operations.

Materials and Methods

The Milas District of Muğla Province was selected as the research area because Gilthead sea bream and sea bass production is very popular there. The research material was based on data that was collected at 24 fish farms operating in the area by conducting interviews and having the interviewees fill out questionnaires at the time of interview.

In this research study, gilthead sea bream and sea bass operations were investigated. The structural conditions and capital structure of the operations were determined, and the unit costs of gilthead sea bream and sea bass were calculated as well.

In determining the value of the current capital elements in the operation, received purchase values of capital elements determined the depreciation values for previous years, based on reduced- and residual-figure values. Straight-line methods were used to calculate depreciation costs (Erkuş *et al*., 1995; Kıral *et al*., 1999). Fixed capital elements are a major part of operational assets, so the calculation of interest costs was of great importance. Generally, depreciation in fixed assets is calculated using a straight-line method, and investment interest is calculated as half the fixed asset value. The interest rate used in this study was a real interest rate, and was taken to be 5% (Kıral *et al.*, 1999).

A specific rate is used to calculate repair and maintenance costs, which are grouped with fixed costs. The cost of annual repairs generally varies between 5–10% of the purchase value of fixed capital, and in this study it was taken to be 7% (Erkuş *et al*., 1995).

Rent prices for areas of land and sea surface were based on annually-determined values for rent paid to Provincial Directorate of Agriculture or the Ministry of Forestry.

The cost of young fish and fish feed in the operations, considered to be variable costs incurred during the production season, were calculated by multiplying purchase volume by unit prices. This calculation was based on the amounts actually paid for medicine, electricity, water, petrol and diesel-oil costs.

In calculating the interest for variable costs, the current interest rate was applied to half the value of the total, variable cost (Kıral *et al*., 1999). Interest rate was taken to be 50% in this study (Anonymus, 2000).

Costs per unit of crop were calculated using the simple calculation method in the operations that were observed in this study. The simple cost calculation method was used in the case of production of a single crop at the end of the production process. In the simple cost method, the value for total cost accrued for the activity was divided by the amount of crop obtained at the end of the activity (Erkuş *et al*., 1995; Kıral *et al*., 1999).

The gross value of production for gilthead sea bream and sea bass were calculated separately by multiplying crop production amounts by unit prices in the operations.

The gross margin of gilthead sea bream and sea bass production activities was calculated by subtracting variable costs from the gross value of production, and the net profit was calculated by subtracting production costs from the gross value of production (Erkuş *et al*., 1995; İnan, 1994).

The following formula was used to calculate feed evaluation rate (Shiav and Chen, 1992):

$$\text{Feed Evaluation Rate} = WFA/ (Ca_2+O) - Ca_1$$

WFA= Weekly Feed Amount / kg
Ca_2= Group weights of fish at the end of a week / kg
Ca_1= Group weights of fish a week before / kg
O = Weight of fish that died either between the two weighings or outside of the trial / kg

Results and Discussion

Structural Characteristics of Operations

All of the fish farm operations in the research area that were studied were established after 1989. 87% of them were operating on domestic capital and 17% were operating on both domestic and foreign capital.

29.2% of the operations in the research area had capacities of less than 50 tons per year (27.86 tons/year), 33.3% had 50-80 tons/year (61.87 tons/year), and 37.5% had more than 80 tons per year (136.67 tons/year). 92% of the operations were

operating at full capacity. The experimental treatment was the fattening of fish (feeding) and the eggs and young fish that were to be fed were provided by the private sector. Purchased young fish were fattened until they became a portion, then brought out on the market. The current production systems in use on fish farms are intensive, semi-intensive, and extensive. All operations in the research area used the intensive production system, which is based on external feeding. All operations in the research area were practising portion production exclusively. All of the fish were marketed live, without being treated with any crop processing method. Gilthead sea bream and sea bass were put in storage in April-June on the operations.

Capital Level of Operations

Fish fattening in cages is a type of production that is gradually becoming more commonplace. In general, high-endurance octagonal cages, made of fibreglass and steel, are used for the purpose of fish fattening in cages in the open sea (Emre and Kürüm, 1998). 5x5 m and 4x4 m wooden cages of lower density and lower cost are used in bays that are protected (sheltered) from waves.

For the operations in this study, all of the 5x5 m cages that were used were made of wood, 93% of the 4x4 m cages were made of wood, and 7% of the 4x4 m cages were made of steel.

Nets are an important part of cages and cage systems. It is seen that nets with interstices that are 4 mm, 6 mm, 8 mm, 10.5 mm, 12 mm and 18 mm on a side are used on the fish farms.

91.6% of the operations in the research area were equipped with a motorboat, lifeboat, or a other watercraft. Fishery operations also had administrative buildings, storage facilities, lodgings and kitchens. Various tools and equipment were used in the process of production on the fish farms. In the case of this study, it was determined that 83.3% of the operations were equipped with a generator, 25% with a net washing machine, 45.8% with pumps, 4.2% with a ventilator, and 33.3% with grading equipment. All operations had rope, an anchor, a skimmer (landing-net), boot, bucket, and balance.

The number of young fish on the operations varied depending on operational capacity in the research area. The operations commenced production with 196,530.3 gilthead sea bream and 161,921.8 sea bass young on average on all of the fish farms. It was decided that granules 2, 3, and 4 would be used as for young fish feed stuff, and 2.0, 3.0, 4.5 mm and 6.0 mm dry pellets would be used as feed stuff for adult fish on the gilthead sea bream and sea bass operations. The feed evaluation coefficient was calculated to be 1.76 for gilthead sea bream and sea bass. From the findings of this study, it was determined that an average of 11,103.5 kg of young fish and 11,551.6 kg of adult fish feed stuff was consumed annually on the farms engaged in gilthead sea bream production, and an average of 9,143.2 kg of young fish and 91,081.3 kg of adult feed stuff was consumed annually on farms engaged in sea bass production.

20.83% of the operations covered in this study used medicine, and no dosage of vitamins was determined. Technical staff, permanent and seasonally hired personnel was employed on the fishery operations in the region. 95.8% of the operations covered in the study hired permanent labour. 3.45 people were hired permanently on average on these operations. As is usually the case in the fishery sector, the amount of technical employment on the operations was low in the research area. Fishery engineers were employed in only 20.8% of the operations, and 0.21 fishery engineer was employed in the operations on average.

It became necessary for the fishery operations to rent a certain area of sea surface on which to conduct gilthead sea bream and sea bass production. In general, gilthead sea bream and sea bass raising operations utilize the coastal region of the rented area of sea as terrestrial area. However, it is not common practice to rent large terrestrial areas. 8.3% of the operations in the research area rented terrestrial area. The average size of rented terrestrial area was 900 m^2 on these operations. For gilthead sea bream and sea bass production, all fish farms operating in the research area rented areas of sea surface for 15 years. These fish farms were operating on an average of 2.24 hectares of sea surface.

The average harvesting weight was found to range between 300–500 grams for gilthead sea breams and sea bass raising operations. Fish were harvested during April–June period and reached harvesting weight in 14–16 months on average. Gilthead sea bream and sea bass were brought out to be sold on the market at a price of $2.10–$2.80.

Production of both gilthead sea bream and sea bass was conducted together in all operations in the research area. The average output of all operations turned out to be 78.9 tons of production and $214 103.67 of revenue. 29.2% of the operations encountered marketing problems. All operations sold their crops to wholesalers. However, 4.1% of the operations sold their crops to restaurants and 16.6% to exporters as well. It was observed that none of the operations in the research area implemented the HACCP programme.

General Capital Structure

The average values of capital were determined to be $5,933.68 for cage capital, $4,499.65 for net capital, $3,953.22 for transport vehicles, $2,971.04 for building capital, and $648.71 for tools & equipment capital.

Operational Costs and Gilthead Sea Bream and Sea Bass Cost

Operational costs are classified according to their characterisation as either fixed or variable costs. These included fixed costs gilthead sea bream and sea bass production, permanent labour, land and sea surface rent fees, and interest calculated for fixed capital elements. Depreciation and repair-maintenance costs were also taken into account. Fixed and variable costs of studied operations are presented in Table 1.

It was observed that costs in gilthead sea bream and sea bass operations varied depending on farm size and production volume. It was calculated that an average of $110,769.20 of the cost was realised in gilthead sea bream production and $80,345.30 in sea bass production, resulting in a total cost that was determined to be $191,114.50 for both operations taken together.

It was observed that 95.10% of the total cost of gilthead sea bream production and 94.84% of the total cost of sea bass production consisted of variable costs. The average variable cost was $105,334.55 for gilthead sea bream and $76,199.20 for sea bass.

Feed costs accounted for the largest single source of all operational costs. The average feed cost was $42,820.77 for gilthead sea bream $34,882.63 for sea bass. The contribution of feed costs to variable costs was 40.65% for gilthead sea bream and 45.78% for sea bass, and feed costs made up 38.66 % and 43.42% of total operational costs for sea bass and gilthead sea bream, respectively. The cost of the young fish, which was one of the variable costs, was 37.37% for gilthead sea bream and 32.03% for sea bass, and the contributions of the two types of fish to the total of all operational costs were 35.54% and 30.38% for both kinds, respectively.

Fixed costs were found to make up 4.90% of the total of all operational costs for gilthead sea bream and 5.16% for sea bass on fish farms covered in this study. The fixed-cost subtotal for gilthead sea bream was $5,434.65, and the corresponding figure for sea bass was $4,146.10. Permanent labour costs accounted for 57.30% and 58.06% of the grand total cost of the two kinds, respectively. The proportion of this cost item in total production costs was approximately 2.81% for gilthead sea bream and 3.00% for sea bass production.

The fish farms operating in Milas-Muğla District produced a minimum of 3,000 kg of gilthead sea bream and sea bass and a maximum of 200,000 kg of both kinds of fish. It was determined that 78,900 kg of gilthead sea bream and sea bass production was realised as the average among all operations. Gilthead sea bream constituted 56.4% and sea bass constituted 43.6% of the total production of the studied fishery

Table 1. The Average Variable and Fixed Costs in Gilthead Sea Bream and Sea Bass Operations

COST ITEMS	Gilthead Sea Bream Production ($)	Sea Bass Production ($)	The Share of Variable Costs (%)		The Share of Fixed Costs (%)		The Share of Total Costs (%)	
			Gilthead Sea Bream	Sea Bass	Gilthead Sea Bream	Sea Bass	Gilthead Sea Bream	Sea Bass
1.VARIABLE COSTS								
Young Fish	39,361.79	24,409.01	37.37	32.03			35.54	30.38
Feed	42,820.77	34,882.63	40.65	45.78			38.66	43.42
Medicine	2.22	1.72						
Energy and Water Costs	2,082.86	1,666.00	1.98	2.19			1.88	2.07
-Diesel Fuel	*841.70*	*706.52*						
-Fuel	*59.08*	*45.67*						
-Electricity	*50.44*	*38.99*						
-Water	*1,131.64*	*874.82*						
Interest on Operating Capital	21,066.91	15,239.84	20.00	20.00			19.02	18.97
TOTAL VARIABLE COSTS	105,334.55	76,199.20	100.00	100.00			95.10	94.84
2.FIXED COSTS								
Permanent Labour	3,113.99	2,407.27			57.30	58.06	2.81	3.00
Land and Sea Surface Rent	432.01	337.21			7.95	8.13	0.39	0.42
Depreciations	923.80	655.74			16.70	15.82	0.83	0.82
-Buildings	*67.03*	*47.09*			*1.23*	*1.14*	*0.06*	*0.06*
-Cages	*334.68*	*258.72*			*6.16*	*6.24*	*0.30*	*0.32*
-Nets	*196.94*	*98.09*			*3.63*	*2.37*	*0.18*	*0.12*
-Transport Vehicles	*267.57*	*205.45*			*4.92*	*4.96*	*0.24*	*0.26*
-Tool-Equipment	*57.58*	*46.39*			*1.06*	*1.11*	*0.05*	*0.06*
Maintenance-Repairs (7%)	710.94	549.60			13.08	13.26	0.64	0.68
Interest of Fixed Capital Elements	253.91	196.28			4.67	4.73	0.23	0.24
TOTAL FIXED COSTS	5,434.65	4,146.10			100.00	100.00	4.90	5.16
TOTAL PRODUCTION COSTS	110,769.20	8,0345.30					100.00	100.00

operations. The production costs for both kinds are $110,769.20 and $80,345.30, respectively. Based on research findings, an average of 44,500 kg of gilthead sea bream and 34,400 kg of sea bass production were realised in the study region. The unit cost was calculated to be $2.48 for gilthead sea bream and $2.34 for sea bass in light of the data presented.

The operations sold gilthead sea bream for the price of $2.68 / kg and sea bass for $2.75 on average. In this way, it was determined that $0.20 was earned on gilthead sea bream fish, whose unit cost was $2.48, and $0.41 profit on sea bass, whose unit cost was $2.34.

The gross value of production was calculated to be $119,599.02 for gilthead sea bream and $94,504.87 for sea bass on average, and the average gross value of production was calculated to be $214,103.89 for all operations in the research area. The average gross margin of the operations for gilthead sea bream production was $14,264.47. The corresponding figure for sea bass production was $18,305.67. The total gross margin of the operations was $32 570.14 for both gilthead sea bream and sea bass production.

The average net profit was $8,829.82 and $14,159.57 for gilthead sea bream and sea bass production, respectively. The average net profit of the operations from both gilthead sea bream and sea bass production activities was $22,989.39 at year's end.

As a result, it was determined that fishery operations that were covered in this research were experiencing technical and financial difficulties.

Current problems and some suggestions for resolving them are presented below:

- The feed factories should be controlled for more sterile and higher-quality method of producing gilthead sea bream and sea bass, and measures should be taken to enhance quality. In addition necessary measures should be taken for high quality-low cost feed production.
- The hunting of fish through the use of chemical substances should be banned in this region in order to prevent damages and/or losses to this type of hunting.
- Health certificates should be made obligatory to help to prevent the spread of epidemic diseases in the provision of young fish. Furthermore, a staff specialist in this field should be employed at the Provincial Directorate of Agriculture and these experts should also be appointed at the district level to deal with the problem of fish diseases. In addition to the above measures, it is very important that fishery engineers be employed on fish farms to prevent and minimize possible losses.
- To enable fishery operations to overcome their financial difficulties, credit with low interest rates, appropriate financial incentives, and support should be provided.
- An investigation should be conducted to determine the negative effect of unregistered operations on the economy, and those that have not registered should be required to do register.
- Organization on fish farms is an issue that must be dealt with to resolve their problems with respect to supply and marketing. 46% of the fishery operations in the research area at the time of the study were members of either a fishery association or foundation. Supporting fish farms' membership in production and marketing cooperatives seems to be a favourable solution to work towards eliminating these problems. So as to obstruct attempts to form monopolies on pricing and marketing, and to increase market share of small- to medium-scale operations and promote continuity between them, it is of vital importance for small- and medium- scale operations to participate in cooperatives or unions.
- To minimize losses arising from a lack of technical knowledge, managers of the operations should be informed about the fishery and management subjects. The Department of Fishery and Farm Economics, within the organizational structure of the Provincial Agriculture Directorate, should take the responsibility.
- Carefully prepared physical planning and feasibility studies of fishery operations, designation, market research and financial analysis based on realistic data and scientific criteria will contribute greatly development of the sector. Moreover, preparation of fishery production projects by an expert or institution will result in more efficient evaluation of resources. Implementation of project confirmation without any political pressure by experts will be a vital issue for healthy investment. From this perspective, project confirmation works should be performed by a committee composed of academicians and related Ministry representatives. In addition, fishery operations should be controlled and monitored at the construction phase if everything is properly performed as it is proposed in the project. The supply-demand balance of the market should be taken into consideration during the confirmation of new production projects.
- Credit support should be offered by Agricultural Bank to prevent problems from arising from instability of the prices of the fishery inputs. Despite their need for credit, fishery operations have not been demanding credit because of complex and difficult bureaucratic procedures and strict credit guarantee conditions stipulated by banks. From this perspective, bureaucratic procedures and guarantee demands of the banks should be adjusted to accommodate to the structure of the sector.
- The fishery operations should be oriented towards processed food production that has high supplementary (additional) value, increase crop diversification, and thus increase demand in the market for their products, to prevent the development of a production surplus in fresh fish and an accompanying decline in prices.

To achieve the above goals, fishery operations should create new marketing chains and realise new investments. In this way, financial support and credit with low interest rate should be provided for the fishery operations.

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