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Economic Feasibility Analysis of Tilapia (*Oreochromis spilurus* Günther) Mariculture in a Seabream (*Sparidentex hasta* Valenciennes) Farm in Kuwait

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Abstract

This study evaluated the economic feasibility of culturing tilapia (*Oreochromis spilurus* Günther) as a secondary crop in a seabream (*Sparidentex hasta* Valenciennes, synonym *Acanthopagrus cuvieri*) farm in Kuwait. The combined species farm with a production capacity of 200 $t \cdot yr^{-1}$ of seabream and 100 $t \cdot yr^{-1}$ of tilapia was compared with a seabream alone farm with a production capacity of 300 $t \cdot yr^{-1}$.

The findings indicate that producing tilapia as a secondary crop in a commercial seabream farm gave higher financial returns. The farm yields an estimated internal rate of return (IRR) of 13.1%, with a negative net present value (NPV) of US$-30,393. In compari-son, a farm producing seabream alone has a lower IRR (11.6%) with a negative NPV of US$-135,861. Results of this economic analysis confirm earlier findings that combining tila-pia culture with seabream production increases the economic returns of a commercial seabream farm.

Introduction

The supply of fresh fish from local catch in Kuwait can no longer meet the demands of the local market. To narrow the gap between supply and demand, about 5,000 MT of fresh and frozen whole fish were imported in 1995 (MOP/CSO 1996). However, local fresh fish is more preferred and commands a higher price than imported fish (KISR 1988a), so the potential of culturing fish in Kuwait is great.

For the past decade, the Mariculture and Fisheries Department (MFD) of the Kuwait Institute for Scientific Research (KISR) has conducted extensive research on the technical and economic viability of aquaculture in Kuwait and has identified seabream (*Sparidentex hasta* Valenciennes, synonym: *Acanthopagrus cuvieri* by Kurunoma and Abe 1986) and tilapia (*Oreochromis spilurus* Günther) as candidate species for commercial culture in Kuwait (Abdullah *et al.* 1989; Al-Ahmad *et al.* 1986; Hopkins *et al.* 1985, 1989; Teng 1987). These findings resulted in the establishment of the first commercial seabream cage farm in Kuwait in 1992.

Feasibility studies on establishing a commercial seabream farm indicate that higher economic returns are possible if fry production (hatchery) is integrated with a grow-out cage system and if tilapia is added as a secondary crop (Al-Ahmad *et al.* 1986; KISR 1988b). More recently, additional information on the production of tilapia has become available (Cruz *et al.* 1994) which could be used to update previously established production parameters (Cruz and Ridha 1989, 1991). Hence, this economic feasibility study analyzes a seabream cage farm with production of 300 tons per year with or without the incorporation of tilapia as a secondary crop using improved tilapia production technology.

Methodology

Production parameters used in this feasibility study are based mainly on results of studies conducted by Teng *et al.* (1987) for seabream hatchery and growout in cages by Al-Ahmad *et al.* (1986) and Hopkins *et al.* (1985) and updated using data obtained by Cruz *et al.* (1994) for tilapia hatchery and grow-out. Technical design parameters used are derived from earlier studies (KISR 1988a, 1988b; 1988c). Costs have been adjusted to the 1997 levels at an exchange rate of Kuwaiti Dinar (KD) 1 = US$3.33.

Capital cost estimates for hatchery and cage grow-out for seabream alone and combined seabream and tilapia facilities are presented in Table 1. Capital cost for the combined species facility is taken as the sum of the costs for seabream and tilapia hatchery facility and cage grow-out facility. Capital cost requirements are calculated based on a production level of 300 $t \cdot yr^{-1}$ for seabream alone and 200 $t \cdot yr^{-1}$ of seabream and 100 $t \cdot yr^{-1}$ of tilapia for the combined species facility.

The capital cost estimates used in this study are based on data presented by KISR (1988c). The incremental costs for incorporating tilapia hatchery system is estimated to be 10% of the system cost for a seabream farm alone. The incremental amount for water system costs is estimated to be 4.0%, representing a small additional expense necessary for internal water distribution. Costs of other equipment are increased.

Estimates of capital costs for the sea bream cage grow-out facility followed those described by KISR (1988c). Capital cost estimates for the tilapia cage grow-out facility are derived by subtracting seabream capital costs from the combined costs. Land cost is nil since it would be located in the sea. Some additional workspace is assumed to be a small increment incorporated into the hatchery building complex.

The approach used in presenting the annual budget schedules is similar to that in the investment costs schedule. Fry produced from the combined species hatchery facility are used directly for grow-out production; revenues from the hatchery enterprise is, therefore, considered zero. Revenues for the grow-out system are derived from the sale of market-size seabream (>800 g) and tilapia (>250 g) at market prices of $8.33/kg and $4.99/kg, respectively. In Year 6, it is assumed that the grow-out enterprise will be able to sell broodstock to outside operations, generating a minor amount of revenue.

The labor cost for the combined species operation is calculated on the basis of the following manpower requirements: one manager, two specialists,

Table 1. Capital Costs and Annual Costs and Returns for the Seabream Alone and Combined Species Facilities (US$'000).

	Seabream Alone			Combined Seabream and Tilapia								
	Seabream	% Total	$/t	Seabream	% Total	$/t	Tilapia	% Total	$/t	Combined	% Total	$/t
Capital Costs												
Hatchery System	1,409.65	52.1	4.70	975.32	49.9	4.88	104.97	38.7	1.05	1,080.29	48.5	3.60
Cage System	1,278.15	47.9	4.26	980.62	50.1	4.90	166.03	61.3	1.66	1,146.65	51.5	3.82
Total Capital Costs	2,687.80	100.0	8.96	1,955.94	100.0	9.78	271.00	100.0	2.71	2,226.94	100.0	7.42
Costs and Returns												
Revenue	2,497.50	100.0	8.33	1,665.00	100.0	8.33	499.50	100.0	4.99	2,164.50	100.0	7.22
Expenses												
Manpower	141.24	7.8	0.47	105.03	8.5	0.53	25.51	8.2	0.26	130.54	8.5	0.44
Hatchery Stock	413.10	22.8	1.38	300.08	24.4	1.50	70.12	22.5	0.70	370.20	24.0	1.23
Feed	928.13	51.3	3.09	624.38	50.8	3.12	183.15	58.6	1.83	807.53	52.4	2.69
Other Consumables	24.65	1.4	0.08	16.10	1.3	0.08	4.08	1.3	0.04	20.18	1.3	0.07
Maintenance	26.87	1.5	0.09	19.55	1.6	0.10	2.71	0.9	0.03	22.26	1.4	0.07
Miscellaneous	76.69	4.2	0.26	15.99	1.3	0.08	4.32	1.4	0.04	20.31	1.3	0.07
Insurance	80.63	4.5	0.27	58.68	4.8	0.29	8.13	2.6	0.08	66.81	4.3	0.22
Depreciation	118.53	6.5	0.40	89.64	7.3	0.45	14.28	4.6	0.14	103.92	6.7	0.35
Total Expenses	1,809.84	100.0	6.03	1,229.45	100.0	6.15	312.30	100.0	3.12	1,541.75	100.0	5.14
Net Revenues	687.66	38.0	2.29	435.55	35.4	2.18	186.20	59.6	1.87	622.75	40.4	2.07

KD 1 = $ 3.33

two administrators, two supervisors, six skilled laborers and ten unskilled laborers. The manager's input is divided equally between the hatchery and the grow-out operations. Within each operation, however, it is assumed that 80% of the manager's and other employees' efforts would be devoted to seabream. Overall, the tilapia total operating expenses amount to about 23% of the seabream total operating expenses.

Insurance (3.0%) and maintenance cost (1%) of physical facilities are calculated as a percentage of total capital costs. Insurance on fish stock is 1.0% of the sales value of fish stock. Miscellaneous expenses is assumed to be 5.0% of the operating expenses. Depreciation expense is directly computed by assuming a service life for each capital cost component. Expenses per ton of fish produced are likewise calculated.

Financial analyses on the production of seabream alone and in combination with tilapia as a secondary crop are calculated using Microsoft Excel spreadsheet program. Components of the financial analysis are internal rate of return (IRR), net present value (NPV) and payback period which are indicators of profitability (Bhandari 1986; Shang 1990). Capital expenditures are allocated during the first two years (Years 0 and 1 of a 10-year horizon), and replacement expenditure is scheduled in Year 6. Residual value of the capital items is assumed to be 10% of initial capital costs. A discount rate of 8.0% is used to calculate IRR, NPV and payback period as estimate of the opportunity cost of the capital (Gittinger 1982).

Results and Discussion

Capital Costs

To establish a seabream alone hatchery, the capital costs is $1,409,650 (Table 1). Total capital costs of the combined species hatchery is $1,080,290. The utilization of a seabream hatchery facility for tilapia fry production contributed to the lower capital cost of the combined species hatchery. There is no additional land required since the additional area for the broodstock and spawning tanks for tilapia can easily be accommodated in the land allocated for the seabream hatchery. Larval and fry rearing tanks for seabream is used only from May-July. During the rest of the year, the tanks can be used to rear tilapia fry. Therefore, no additional capital cost is needed for rearing tilapia fry. Furthermore, no additional vehicle is included since the vehicle used for seabream can be shared with tilapia. Overall, the tilapia hatchery facility cost estimated here is about 14% of the base cost for a seabream hatchery.

The capital cost of the cage grow-out facility is $1,278,150 and the total capital cost is $2,687,800 for seabream alone. The capital costs of the cage grow-out facility is $1,146,650 and the total capital costs is $2,226,940 for the combined species production system. The major cost items in the grow-out cage farm are the cages and nets, which represent 24.0% of the total capital costs. Capital costs can be reduced by moving the cage facilities to a more protected area, so there is no need to buy more expensive cages that could withstand strong waves. The capital costs per ton of the combined species have been

computed to be $9,780 for of seabream and $2,710 for tilapia. Overall, the aggregate capital costs per ton of the combined species is $7,420 and, for seabream alone, $8,960.

No additional boat is required with the addition of tilapia in a seabream cage farm. Hence, the cost of the boat in the combined production farm is distributed between the two species rather than solely charged to seabream in a seabream alone farm.

There is still the potential of further reducing the investment costs for tilapia by using nets with greater depth to increase the production per unit area of cage net. A study conducted by Cruz *et al.* (1994) tested net cages up to 3.0 m deep using 2.2 x 2.5 m net cages. Further culture trials are needed to test the possibility of increasing tilapia production per unit area of net cages using deeper and wider nets.

Annual Costs and Returns

Revenues and operating expenses for both the seabream alone and combined species production systems are presented in Table 1. Operating expenses for the production of tilapia is lower than those for seabream because tilapia production is technically easier than seabream production. Tilapia is also a more efficient converter of feed into fish flesh; market size is attained within one year; feed cost is lower; production per unit area is higher and mortality is lower compared to seabream.

The major operating expense for both seabream and tilapia production is feed cost, representing 52.4% of the total expenses or 56.2% of the operating costs (total expenses less depreciation costs). These results are comparable to those observed in other species grown in cages. For grouper (*Ephinephelus salmoides* Maxell) and channel catfish (*Ictalurus punctatus* Rafinesque), the cost of feeds constitutes 46.5-58.3% and 56.8% of operational costs, respectively (Chua *et al.* 1980; Collins and Delmendo 1980). Since feed cost constitutes more than 50.0 % of total operating costs, the fish culturist should try to find ways to reduce feed cost and keep the feed conversion as low as possible to maximize the net revenue.

The cost of fry (purchased at cost from the hatchery enterprise) is the next largest expense, constituting 24.4% and 22.5% (equivalent to total expenses of $300,080 and $70,120) for seabream and tilapia, respectively. Manpower is the largest cost component in the production of fry. It constitutes 35.0% and 36.38% of the total costs for seabream and tilapia, respectively. The data obtained for tilapia hatchery are comparable to those obtained by Head and Watanabe (1995). Manpower used is the minimum requirement to run a hatchery. This minimum manpower however, is capable of producing more fry than what is needed for the size of the farm. Producing fry beyond what is required by the farm will reduce the cost of fry while selling excess fry to other farmers will provide additional revenues.

The next largest expense after fry cost is labor cost representing 8.5% and 8.2% for seabream and tilapia, respectively. The rates used for the manager, specialist and labor supervisor are based on levels acceptable to first world

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