A Comparison of the Financial Feasibility of Three Offshore Cage Systems for the Production of Sea Bass in the Mediterranean

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INTRODUCTION

Today cage manufacturers can offer different systems that significantly vary as for design, economic operation parameters and cost. Choice of a particular system considerably depends upon hydrometeorological conditions of the given area.

With increasing offshore storm danger increases, which stipulates special requirements to creation of cage farms at exposed areas.

There are different types of systems specially designed for application at exposed water areas. Generally, these systems are divided into three main groups: floating, semi-submerged and submerged systems. It is very difficult to compare them, for technical differences within one group are often greater than between systems of different groups. However, for open sea conditions the fundamental choice of a system is directly connected to ultimate limits characteristic for each of the three groups.

Thus, floating systems can be deployed at places with maximum wave height below five meters and semi-submerged systems can be placed with waves exceeding seven m. From engineering point of view, calculation of a system on wave impact can provide a 100 percent guarantee of the structure strength under storms. This is due both to the complexity of wave process and to inexpediency of calculation of storm impacts that occur once every hundred years (that would lead to considerable rise in cost of the structure).
Guaranteed safety of the structure and fish by deploying the system at exposed areas can be obtained when using the wave impact zone, i.e. by using underwater systems, which operate with rather external impacts.

There is an opinion about underwater systems being expensive and complicated to use (L. Dahun, 1995). Based on the experience of existing enterprises, average data in the industry, and comparative financial analysis of the operations, we shall try to see the truth of such an opinion.

This paper is based on studies of specialists from the University of Strathclyde (D.C. Sneath, JF Matt and DA Robertson, 1993) devoted to estimation of financial impact of a sea-bream on-growing farm which applies two types of cage systems - exposed area a semi-submerged one (PRAMOCHEAN 350) and floating one (DUNLOP Tempest 2).

According to the authors, the main difference between these two systems is the difference in work of the cage systems and labor cost per unit production. Non-equivalence of the volume of the cage of the floating system to the effective growing volume owing to significant deformation of the net chamber under current impact (20%) was taken into consideration when calculating the required number of floating cages.

On adding a third member, i.e. underwater cage system into the comparative analysis, necessity to more thoroughly study the differences between the systems arose when constructing a production and financial model.

The aim of the paper lies in evaluation of comparative financial efficiency of three cage systems: floating, semi-submerged, and submerged when applied for sea-bream farming.

All three systems have been successfully used in salmon farming at exposed areas, and at present farmers have begun to apply them for sea-bream and sea-bass farming in the Mediterranean.

In this connection it was not the average data in the industry that was used when determining the survival rates and FCR (feed conversion rate), but experience of definite operators, which enabled application of average data on three cage systems in the analysis.

Comparison of these types of cage systems was executed both from the point of view of investment decision and from the point of view of profitability and risk.

METHODS

From salmon farming experience we know that operations with output exceeding 100 kg/year are most efficient (Skaug et al., 1985). This is due to both full utilization of facilities capacity and reduction of expenses on purchase of stocking fish and feed, and, certainly, with market advantages.

Based on "economy of scale" we assumed model operation with a productivity level of 250 kg of sea-bream per year, which is the most popular species for farming in the Mediterranean.

Taking into account local climatic conditions and to provide for continuous production, a twelve-year stocking pattern was assumed. Production cycle of farming 25-30 gram fry in enclosures at 300-400 gram fish was taken as equal to 10 - 12 months in accordance with the experience of actual operations farming sea-bream and sea-bass.

The production model is based on technological assumptions, which are based on both average experience in the industry and average experience of individual operations.

Thus, 93 percent survival rate was assumed for a floating system, based on average experience in the industry that use floating cages 95 percent - for submerged cage, and 98 percent - for a submerged one, based on the data from real, operating farms.

Difference in the survival indices is directly connected with influence of stress-factors during fish
In accordance with this index, a five-year life cycle for the project was assumed.

As when determining the payback period, the cash flow after the payback period and the time value of money are ignored, the IRR method was applied.

When estimating the IRR, repayment for loans and interest on loans were not considered. The projects were financed with 100 percent equity IRR, which indicates the return of the capital investment was positive for all three projects and exceeded 25 percent, which lets us presume that the project will be able to service the loan capital, but to be on the safe side, we should extend the project life cycle to 10 years.

The drawback of IRR for investments estimation is the fact that it does not directly consider the amount of investment. The latter is significant when choosing the type of a system for farming at exposed water areas.

The NPV method enabled us to evaluate the investment decision taking into account both cost of investment and cash flows and time value of money. When calculating NPV, the cost of capital was assumed 10 percent. All three projects showed positive NPV with linear depreciation, 10 percent tax rate and inflation not considered.

Profitability is the most important criterion when determining the efficiency of an enterprise, but it is also necessary to consider profitability in relation to risk.

In order to calculate profitability and risk, the following parameters of financial activity of the assumed production model were chosen: unit cost of production, capital requirements, IRR sensitivity analysis, and when determining production costs, cost of packaged farmed sea bass, whole fish with delivery to the nearest shipping center, was assumed. Unit production cost above normal price that should be obtained per kilo of commercial fish to avoid unprofitability of the project. This gives us a measure of the risk involved.
In the project, showing maximum price which the project will turn a profit. With more than 10 percent reduction of the whole-scale price, the projects under analysis become unprofitable.

When determining the capital requirements, we considered the capital costs and working capital.

Application of new technologies that enable fish farming at exposed areas requires more significant investments than when using conventional systems.

At the same time, new technologies enable reduction of production costs of producing a higher quality product, reduction of feed and feed costs, increased yields, increased fish growth speed and, correspondingly, return on equity.

When determining the project sensitivity to changing of procurement prices of commercial fish, i.e. when estimating risk, we calculated returns of the capital investment over the project life and reduction.

With a 10 percent rise in price, the IRR reached 52 percent, while with a 15 percent reduction, only one project with application of floating cages showed negative IRR and great dependence on price.

DISCUSSIONS

The most significant difference between submerged and floating systems lies in the food supply system and availability of a rigid framework.

Semisubmerged and submerged systems equipped with automatic feed provide for feeding even during unfavorable weather conditions and storms, which considerably reduces the operational labor cost of running a farm.

The automated feeding system provides for setting effective feeding regimes, which enables reduction of feed costs due to a more efficient FCR.

Availability of a rigid framework in such structures provides for constant volume and shape of a set, both under unfavorable weather conditions and strong sea currents, which contributes to reduction of stress and increase of effective growing volume.

Submerged systems, unlike semi-submerged ones, are fully protected against storm impact owing to an underwater position of the system during farming. An underwater position of the system enables reduction of erosion and fouling of the set by an order of magnitude, which increases the life cycle of the structure and prevents stress of the fish turned. This produces a higher-quality product.

The underwater feeding system provides for fish feeding during storms without feed loss, which is impossible with floating and even semi-submerged systems.

Submerged systems and floating ones especially, require less capital investments and their units are of less volume, which provides for greater flexibility in production planning.

At the same time, only submerged and semi-submerged systems are characterized by constant sea chamber volume, guaranteed fish safety during storms, and they enable the operator to avoid manual feeding.

RESULTS

When estimating an investment decision using the NPV method, maximum NPV = 125 was observed for the project with application of semi-submerged cages.

Capital costs when using semi-submerged cages were 43 percent higher than for floating ones. Application of submerged cages reduces capital costs per farm as compared to a farm that uses floating cages by 10 percent.

The amount of capital costs effects and production costs by accounting depreciation. Production costs increase with higher capital costs correspondingly, i.e. for submerged and semi-submerged systems, but they are compensated by lower labor costs, lower feed.
costs, better survival rate, and higher quality of end product. Unit production costs for floating systems are three percent higher than for semi-submerged ones and nine percent higher than those for submerged ones.

Capital requirements for semi-submerged systems are 13 percent and for floating systems are four percent higher than for a farm using submerged systems.

IRR for farms that use floating cages is 29 percent, 27 percent - for semi-submerged, 24 percent - for submerged, with market prices.

With rise in price up to 10 percent, IRR for these projects shall be 50 percent, 43 percent; and 52 percent, respectively, with reduction in price to 15 percent, it shall be 40 percent, nine percent and six percent, respectively.

Economic value added when investing in the farm that applies floating cages is $406,000; semi-submerged ones $417,000; submerged ones $592,000, as compared to investments in government bonds with interest interest rate equal to 8 percent.

CONCLUSIONS

Semi-submerged and submerged systems, in particular, are suitable for application at exposed areas at the Mediterranean.

Operations that use submerged cages are most effective.

All three systems demonstrated attractive IRR, from investment point of view.

Sensitivity analysis of IRR with rise and reduction in price showed high efficiency of floating systems at rise in price and low efficiency at reduction in price, and higher stability of semi-submerged and submerged systems.

All financial indices confirmed the superiority of underwater systems over semi-submerged and floating ones.

REFERENCES

