

Red-drum (*Sciaenops ocellata*) farming in Martinique: a new prospect for Caribbean marine aquaculture ?

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Philippe Paquotte, IFREMER, Service d'économie maritime, France.

Abstract

Like most other Caribbean islands, Martinique suffers a reduction in fisheries resources and is now a net importer of seafood products since no major expansion of aquaculture production has been done. Nevertheless, this island has numerous assets for marine aquaculture development : tropical clean waters, developed infrastructures and market channels, financial support for research, training and extension due to its tight political and economic connection with France. Red drum is a subtropical fish introduced in Martinique in 1985 from the south of USA for aquaculture purposes. From 1987 to 1993, IFREMER worked on rearing techniques in Martiniquan conditions. Once the farming techniques were perfected, questions raised about red drum marketing potential and of economic viability of red drum farms in order to attract investments and entrepreneurs. That is the reason why a market analysis and a financial analysis have been carried out. The results of these studies indicate that Martiniquan fish farming could be profitable, due to the rapid build-up of the facilities and to the short production cycles. The good quality of infrastructures in Martinique, the high purchase power of the population in comparison with most Caribbean islands and the frequent air links with Europe are important comparative advantages. The market analysis has revealed a good potential on the domestic market thanks to the development of the supermarkets, but has underlined the price constraint. For the French market too, production costs have to be lowered in order to compete on a market dominated by salmon.

key-words: aquaculture, Caribbean, coastal management, seafood market study, economic analysis

AQUACULTURE DEVELOPMENT IN ISLANDS: ECONOMIC CONSTRAINTS AND ASSETS

Like any other economic activity, aquaculture has to face some specific constraints due to the insular context. Transport to and from the islands is more expensive and less regular, which has a negative impact on the price competitiveness of the insular products (Hein, 1988). Some extra costs have to be considered in order to cover transit and storage operations. Islands are also more subdued to problems of traffic congestion in airports, harbours or even telecom networks. In some islands, real estate has turned out very expensive due to tourist pressure. Economic development may suffer also from a lack of technical and scientific formation structures which obliges to rely on outside for technological transfer and graduated manpower.

Local markets are often too small to make it possible for the enterprises to develop first at a domestic level and to take advantage of economies of scale. In the case of a new activity like aquaculture, the firms usually have to face international competition on export markets as soon as they start up despite the disadvantages in terms of transport costs they have to cope with. Given the new rules of free trade for sea products following the GATT agreement, the same constraint of international competition will have to be taken into account by all islands, whatever particular trade agreements they are involved in at the present time.

Most often, the small islands belong to the middle income range of developing countries with very high structural unemployment, especially in islands with greater income. Strong balance of payment constraints are caused by a very high income-elasticity of imports. Hence, any profitable activity which would provide a large amount of foreign currency and significant employment is welcome (Salmon, 1997).

The success of marine fish farming in the Mediterranean islands proves that aquaculture may be a good strategy for development in islands. In 1997, 30% of the Mediterranean marine fish farming production came from farms located in islands, accounting for almost 20 000 tons of seabass and seabream. According to a survey carried out in 1997, the reasons why so many enterprises have been established on islands are very diverse. Taking advantage of good environmental conditions is the most common motivation, since islands are usually less submitted to constraints due to town extension, industry development or intensive agriculture. In some cases, another valuable asset may be the temperature pattern which fits much better the fish requirements. That is the case of Corsica in comparison with mainland France, and especially of Canaries and Madeira which have the advantage to be in the flow of the temperate Gulf stream. Thanks to higher temperatures in winter, the growth cycle may be considerably shortened which gives less risk and better capital productivity (Paquotte and Lacroix, 1997).

Because of its dependence on a natural resource which is the water with all required characteristics in terms of nutrients, temperature and cleanliness, aquaculture may be considered as a « resource oriented » activity. It means that access to inputs should have a larger influence than access to the market in the choice of the location of such an activity (Temri, 1997). But although favourable natural conditions are necessary, they are not sufficient to give long term viability to aquaculture projects. Other parameters have to be taken into account, like cost and availability of inputs, level of wages, synergy or competition with other activities, social context or public policy.

In the case of Mediterranean aquaculture, European incentive policy towards ultra-peripheral or late development regions has made it possible to attribute specific subsidies to islands for aquaculture in the aim of more employment and wealth. When islands are state-islands, like Malta and Cyprus, or autonomous regions far from their mother country like Madeira or Canaries, economic independence is at stake and may be a strong motivation to develop aquaculture as a factor of food security and self sufficiency. On the contrary, the labour cost does not seem to be a major attractive factor for aquaculture development in Mediterranean islands. This may be explained by the fact that most of these islands belong to developed countries where labour cost is high, as well on mainland as on the islands.

THE EXPERIENCE OF AQUACULTURE IN THE CARIBBEAN AND IN MARTINIQUE

The Caribbean region encompasses heterogeneous islands along an arch from Venezuela to Florida, between 10° and 20° North. Although geographical, political and cultural parameters are very diverse in the Caribbean, there are natural common features like good quality warm water, trade winds and occasional hurricanes. The fisheries of the Caribbean consist primarily of nearshore species and exploitation of pelagic fishery resources has just started. Expansion of the tourism industry, increase of per capita income and incentives to export products to markets in the United States and Europe have led to overexploitation and major reduction in fisheries resources throughout the region. Today, all Caribbean islands have become net importers of seafood products, which explains their strong but late interest in aquaculture (Creswell, 1997).

Most of the successful aquaculture projects have been with freshwater species, the giant prawn (*Macrobrachium rosenbergii*) and the tilapia (*Oreochromis spp.*) especially in the Greater Antilles (Cuba, Jamaica, Puerto Rico). But despite a significant world-wide development, marine aquaculture is not yet a common activity in the Caribbean region. The reasons of this late development are the paucity of knowledge related to the biology and husbandry of marine indigenous species, the weakness of

infrastructures, the difficulty to use offshore sites, the lack of trained manpower, the limited number of academic institutions, their lack of funds, the lack of specific institutional context and the poor scientific regional cooperation (Lacroix, 1997).

The development of aquaculture in the French West Indies (Martinique and Guadeloupe) began in 1976 with the introduction of the giant freshwater prawn (*Macrobrachium rosenbergii*). This activity has been successfully launched by small scale producers and has been supported by dedicated governmental agencies through education, extension and European financial incentives. The production of prawns was also spurred on by the fact that prices were relatively high on the local market since local freshwater prawns were traditionally consumed in these islands. Despite the fact that local production now has to face foreign competition, mainly from South East Asia, it still maintains itself at an average yearly production of 70 tons because of the advantage of delivering a fresh and locally made product (Buchet, 1997). In 1988, producers in Martinique began to rear hybrids of red tilapia (*Oreochromis spp.*). This activity today has tapered off at a level of 60 tons of production per year, mainly due to the fact that the local market does not appreciate fresh water fish as much as marine fish.

POTENTIAL MARKETS FOR FARM RAISED RED-DRUM

The red-drum (*Sciaenops ocellata*), a marine fish from the South of the United States was introduced in this area in 1985. After preliminary research and adaptation to the local context, the biological cycle was under control in 1993 and developers are today looking at the setting up of rearing facilities of this species in floating cages. This activity has just recently begun in Martinique with three entrepreneurs undertaking small scale projects aiming at producing a few tons per year for local consumption.

Nevertheless, local authorities and local development agencies as well as French Government representatives in Martinique have asked for relevant information in order to support this new activity. Indeed, premature investment in unproved marine aquaculture projects has resulted in numerous failures in different Caribbean islands and in reticence from financial institutions and venture capitalists to provide loans for an industry with such a risky financial history (Creswell, 1997). That is the reason why both a market analysis and a project analysis have been carried out in order to assess the potential market for red-drum and the profitability of red-drum farms in Martinique.

Local market

The consumption of fresh fish per capita is around 30 kg in Martinique. Half of the 10 500 tons of fresh fish which are consumed every year in Martinique are imported. Three marketing channels are present. The

traditional one through local wholesalers or through direct sale by small scale fishermen is receding, whilst imports by hotels or by supermarkets are increasing. Nevertheless, there are no accurate data concerning these new distribution channels.

Most local consumers may be classified as «connoisseurs» since there is a real tradition for cooking and eating fish in this island. So, red-drum which appears as a new product may not be easily a substitute for local fish. Two types of fish are offered in the supermarkets: small whole fish with bright colours like snapper (*Etelis oculatus*) which are priced around 11.0 US\$/kg and steaks of pelagic like wahoo (*Acanthocybium solanderi*), kingmackerel (*Scomberomorus cavalla*) and dolphinfish (*Coryphaena hippurus*) priced around 12.0 US\$/kg. Farmed tilapia is not rated so high as local fish by Martiniquan consumers despite its red colour since it is a freshwater fish, non indigeneous in addition. So its price does not exceed 8.0 US\$/kg as fresh fish or 9.0 US\$/kg alive.

On behalf of the Martiniquan local authorities so called « Conseil Régional de Martinique », a market study for red-drum and tilapia has been carried out in 1995 by a consulting company belonging to the group CEPKOM-SOGEFI. This study has pointed out the difficulty to introduce a new species among connoisseurs despite the fact that all the consumers of the test panel have appreciated the look, the taste and the freshness of farm raised red-drum. As far as tablecloth restaurants are concerned, the preferred size would be around 400 to 600 g individual weight and the wholesale price should not exceed 8.0 US\$/kg. The main request from the restaurant owners is the regularity of the supply as they could not include red-drum in their menu if not sure to be delivered every week. For household consumption, the main constraint is the lack of notoriety and of image of red-drum in Martinique. Nevertheless, supermarket consumers which are not as demanding as traditional consumers are ready to buy this new product as long as it is priced below 9.0 US\$/kg. As supermarkets dramatically increase their market share in Martinique, promising outlets may be expected for red-drum, at least 1 000 tons per year in a few years (CEPKOM-SOGEFI, 1995).

Export markets

American market could be a potential target for Caribbean fish farming, given its geographical proximity. Over the last decade, average per capita fish and seafood consumption has remained relatively flat in the United States, at around seven and half kilo, roughly 1 to 2 kilo less than turkey consumption. However, over this time period, the source of seafood products has been shifting away from wild harvest and toward aquaculture. In 1997, US production of processed catfish products was closed to 500g per capita, imports of farm-raised shrimp were likely over 500 g per capita and the combination of farm-raised

salmon, trout, tilapia, crawfish and other aquaculture products probably added another half kilo. With about 20% of US fish and shellfish consumption now being farm-raised, aquaculture is becoming a recognised segment of the food sector in the United States (Harvey, 1998). Nevertheless, the level of price on the American market is much lower than on the Martiniquan market. Indeed, ex-farm price for catfish is around 1.5 US\$/kg, price for tilapia imports just fell below 2.0 US\$/kg and price for salmon imports is around 3.0 US\$/kg. Moreover, communication means between Martinique and the United States are scarce and expensive, unlike with Europe, and Martiniquan exporters have little practice of the American market rules.

On the contrary, daily direct air connections exist between Martinique and metropolitan France, with very low fare for freight, likely under 1.0 US\$/kg. The French market is easy to reach and attractive since the demand for fresh fish has been on a positive trend for a few years. Imports of tropical fish in France have reached 5 500 tonnes in 1996 (Cofrépêche, 1997), not only for ethnic niche market but more and more as substitute for seabream or sole. Nevertheless, an in depth transformation of market conditions is ongoing in France along with other European countries. The most important issues are the soaring role of supermarkets in the distribution chain, the development of new processing techniques like pre-packed fresh fish, the growing importance of catering and the evolution of the consumer's behaviour.

The increasing market share of super/hypermarkets in European seafood distribution is a very important issue for aquaculture development. Indeed, marine fish farming has been focusing so far on the market for fresh seafood because of high production costs. Now, thanks to their good equipment in fresh food counters, super/hypermarkets have proved to have positive effects on fresh fish sales in country or regions where fresh fish consumption was traditionally low. The counterpart of this opportunity is the obligation to comply with the specific requirements given by the supermarkets. These requirements turn on supply regularity, availability of a range of products and homogeneity of characteristics for each type of product. It has to be noticed also that the increasing consumption of fresh fish in most European countries is due to steaks and fillets rather than to whole fish. In France for instance, fresh steaks and fillets fish have reached a 60% market share in super/hypermarkets in 1996 but only 45% in traditional outlets (FIOM, 1997).

On the French market, there is a wide range of retail price for whole fresh fish with quite homogeneous quantities from less than 4.0 US\$/kg to more than 11.0 US\$/kg. Because of the continuous price decrease of salmon, there is now a first pick around 5.5 US\$/kg, under the average price for whole fresh fish which is now around 8.0 US\$/kg. But there is still a strong demand for more expensive fish between 11.0 and

13.0 US\$/kg, like sole, turbot, anglerfish and seabass. As for steaks and fillets, their distribution is much more concentrated in the range 9.0 to 11.0 US\$/kg where most of the popular species are mixed. It looks like whether the name of the species was less important for steaks and fillets than for whole fish, since on the one hand there is a limited number of available species and on the other hand there is very few price differentiation between species (Paquette, 1998).

So, there seems to be a large market potential for red-drum on the French market if this new species can be delivered in steaks and fillets at a retail price around 12.0 US\$/kg, which means a regular production of fish above 800 g at an ex-farm price under 4.0 US\$/kg. One of the main advantages to target this type of market is that an increase in production due to aquaculture would not have a major effect on the total supply in this category of product and would not lead to such a price crush as it has been observed for seabass and seabream in the Mediterranean area (Paquette, 1998).

ESTIMATED PROFITABILITY OF A RED-DRUM FARM IN MARTINIQUE

In order to assess the financial feasibility of the husbandry practices developed for the red-drum, IFREMER Aquaculture Research Centre in Martinique and IFREMER Marine Economics Service have realised together a project analysis (Houel S, Falguiere J.C. and Paquette P., 1996).

Two production types have been studied, i.e. a small scale farm (20 Tons/year) and a semi industrial farm (200 Tons/year). Two commercialisation sizes were considered, the 350g fish mostly for restaurants and the 800g fish. The last one can be processed and is more dedicated to supermarkets or to export.

Zootechnical data obtained in cage culture in Martinique are summarised in table 1. Extension of growing period to 800g involves the use of a pregrowing phase from 2g to 200g. Full production regime (2 cycles per year) is obtained respectively at year 2 and 3 in 350g and 800g production systems, the first year being devoted to project design, to administrative procedures and to build-up of facilities.

Semi industrial farms need specialised facilities and qualified technical labour : 1 project manager, 1 accounting secretary, 1 aquaculture technician and 6 workers. Small scale aquaculturists only call in day labourer aid when necessary for specific work and use local or self made facilities. Small scale farms distribute their production to proximity customers (restaurant) whereas semi industrial farms sell the fish directly on the site to wholesalers who distribute it to local supermarkets or to export. Selling price assumptions are adjusted to the different commercialisation types according to the results of the Martiniquan fish market survey (Table 2). The same price is assumed for 350g fish and for 800g fish.

A technical and financial analysis of these projects has been carried out in order to assess and to compare the economic feasibility of a small-scale production system with that of a semi-industrial one. The main criteria of this project analysis are the profitability of the activity at a steady state, the average production cost, the profitability of the funded capital and the assessment of the financial requirements during the build-up period (Table 3). This analysis has been carried out with an estimated price of 0.6 US\$ per juvenile at individual weight of 2 g. At the present time, the production cost of red-drum juveniles in a small scale hatchery is higher, but could be easily reduced in industrial conditions, as it has been happening in Europe for seabass and seabream juveniles.

Table 1. Zootechnical data for red-drum in cage culture in Martinique

Initial weight	Final weight	Duration	Survival	Maximum biomass	Commercialisation period	Food conversion ratio
2 g	350g	158d	85 %	30 kg m ⁻³	8 weeks/cycle	1,74
2 g	800g	245d	79 %	28 kg m ⁻³	11 weeks/cycle	1,77

Table 2. Estimated selling price of red drum in Martinique

Type of farm	Type of fish presentation	Type of commercialisation	Selling price
Small scale	whole	delivered to restaurants	8.6 \$ kg ⁻¹
Small scale	scaled and gutted	delivered to restaurants	11.0 \$ kg ⁻¹
Semi-industrial	whole	ex-farm price for supermarkets or export	7.4 \$ kg ⁻¹

Table 3. Results of the financial analysis (on the basis of 1.0 US\$ for 6.0 French Francs)

Type of project	Small scale (350g fish)	Small scale (800g fish)	Semi-industrial (800g fish)
Ratio of profitability in routine (net profit/annual sales)	21%	28%	36%
Average production cost in routine (whole fish)	6.0 US\$ kg ⁻¹	5.4 US\$ kg ⁻¹	4.3 US\$ kg ⁻¹
Investment	60 000\$	67 000\$	750 000\$
Payback period	3 years	3 years	4 years
Internal Rate of Return at 10 years	55%	60%	56%
Net Present Value at 10 years (discount rate = 9%)	147 000\$	192 500\$	2 246 000\$
Financial requirements during the build-up period (investment + working capital)	100 000\$	117 000\$	1 250 000\$

Production costs are lower in the semi-industrial projects than in the small-scale ones, thanks to better capital productivity and better labour productivity. The results of these studies indicate that Martiniquan fish farming could be profitable, due to rapid build-up of the facilities and to short production cycles. Estimated ratios of profitability are above 20%, which should be enough to take into account the risks inherent in any aquaculture project. Nevertheless, the estimated profitability of a small scale farm producing 350g fish is not so good as for projects producing larger sized fish (800 g). It may be even considered as too low for an innovative project in a country with few experience in the field of marine aquaculture since such a project would be quite risky.

The reason why production costs are higher for small fish is the need for more juveniles to produce the same

weight of edible fish, as it appears in the breakdown of production costs of the different projects (Table 4). A comparison with seabass farming in the Mediterranean shows that red-drum farming has a better labour productivity and a better yield per volume of cage (Table 5).

The results of the sensitiveness analysis show that the profitability of a small scale farm is hampered by any increase of the price of juveniles. As for the semi-industrial project, it would be profitable as long as the price of the juveniles does not exceed 1.0 US\$ each or as long as the selling price does not fall down below 6.0 US\$/kg.

Table 4. Breakdown of production costs

Type of project	Small scale (350g fish)	Small scale (800g fish)	Semi-industrial (800g fish)
Juveniles	32%	17%	22%
Feed	24%	27%	36%
Labour	25%	32%	21%
Depreciation	9%	12%	10%
Miscellaneous	10%	12%	11%

Table 5. Technico-economic ratios for seabass farming in France and red-drum farming in Martinique.

	Red-drum semi-industrial plant (800g fish)	Seabass semi-industrial plant (350-500g fish)
Labour productivity (tons.year ⁻¹ .employment ⁻¹)	23	14
Annual yield per volume of cage (tons.years ⁻¹ .m ⁻³)	36	12
Estimated ratio of profitability	36%	22%
Pay-back period	4 years	7 years

DISCUSSION

In a first approach, marine fish farming seems to be a good opportunity for Martinique since this activity takes advantage of the natural resources of this island, i.e. clean water, high temperatures all year long and sheltered bays. Thanks to these natural advantages, a fast growth is expected for red-drum and consequently low production costs. It may ensure competitiveness on the seafood market despite the additional costs due to the islander context. Nevertheless, attention should be paid to the risk of storms and hurricanes in this part of the world. The expected profitability should make it possible to provide sort of a self-insurance, but only if the entrepreneur has enough cash flow during the start-up period. Even in the case of a small scale project, the financial requirement to build up the project till the routine phase has to be taken into account.

The sensitiveness analysis has highlighted the great influence of seed price, particularly in the case of small scale farms producing portion size fish. As long as industrial farms are not implemented, the demand for juveniles will be too low to take advantages of economies of scale in large hatcheries, and the price of juveniles should be subsidised. The development of such industrial farms is necessary to reduce the production costs in order to give price competitiveness to Martiniquan farm raised red-drum. Indeed, the present production costs of red-drum in Martinique have to be lowered to fit the demand as well on the local market, where a price premium is given to traditional fish at the expense of other species like red-drum, as on the French market where the cheap Norwegian salmon has become price-leader. Productivity gains are expected through better control of husbandry practices but the industrial development has to be supported by research in genetics, nutrition and pathology and by good structures of technological transfer.

The issue of economic development in small islands is very intricate and usual decision making tools like financial analysis or market analysis are not sufficient to build development strategies or justify investment choices. Muir and Young (1998) have established a list of elements which have to be considered in a strategical approach for new development in aquaculture, including structural analysis of key stakeholders and social analysis. According to this type of approach, Martinique has comparative advantages in comparison with other Caribbean islands which are important in order to give confidence to wouldbe investors. These advantages are the good quality of infrastructures (electricity supply, roads...), the institutional support (research and development facilities, extension services, training, access to European incentives...), the availability in capital from the agricultural sector, the high purchase power of the population, the existence of an active and modern distribution chain with good control of refrigerating and the frequent air links with Europe.

Nevertheless, the specific political and social context of Martinique should be taken into consideration in order to develop long term activities.

An other important asset which has to be taken into account by Martinique is the positive and attractive world-wide image of Caribbean islands. The strong symbolic image of islands is a non merchantable good which may be used as a competitive advantage by aquaculture producers. This could be done through the promotion of quality products based on a geographical origin, the quality of the environment or specific production processes. Such an approach is not usual yet because of the lack of objective criteria for product differentiation in fish farming at the present time (Paquotte, 1995). Such a marketing policy would make it possible to go beyond a short term strategy based on natural favourable endowments. An alternative strategy could be to try and construct a set of norms and specifications related to the Martiniquan culture and territory in order to consolidate a specific quality, as it has been done for agricultural products in Mediterranean islands like Sardinia and Sicily (Filippi and Torre, 1996) or for cosmetic products in tropical islands like Tahiti.

Although marine fish farming is a new activity in the Caribbean and in Martinique, it may take advantage of the experience from other parts of the world. For instance, in small Mediterranean islands where space is a scarce resource, offshore fish farming has proved to be the major way to develop aquaculture. Indeed, it makes it possible to avoid use conflicts with coastal tourism and to have access to clean water. Thanks to the transfer of Norwegian offshore cage technologies to Mediterranean conditions, technical constraints have been solved by Mediterranean producers. The same transfer could be operated in the Caribbean, but it should be accompanied by transfer of know-how. Indeed, running an industrial fish farm using large offshore cages requires specialised husbandry and managerial skills. That is the reason why joint-ventures between local investors and newcomers already involved in fish farming are necessary. They are also important to give to producers easier access to non-Caribbean markets.

An other important asset which has to be taken into account by Martinique is the positive and attractive world-wide image of Caribbean islands. The strong symbolic image of islands is a non merchantable good which may be used as a competitive advantage by aquaculture producers. This could be done through the promotion of quality products based on a geographical origin, the quality of the environment or specific production processes. Such an approach is not usual yet because of the lack of objective criteria for product differentiation in fish farming at the present time (Paquotte, 1995). Such a marketing policy would make it possible to go beyond a short term strategy based on natural favourable endowments. An alternative strategy could be to try and construct a set of norms and specifications related to the Martiniquan culture

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