

Potential for Sustainable Aquaculture Development in Mauritius



Lagoon aquaculture farm in the South East of Mauritius

Board of Investment

*Ministry of Agro-Industry and Fisheries
(Fisheries Division)*

December 2007

1 Aquaculture

Aquaculture is farming of fish, shellfish and aquatic plants in fresh or salt water. Aquaculture products are grown in earthen ponds, freshwater lakes and bays, or in the open ocean. The fish are fed and cared for to ensure optimum health and product quality. Aquaculture is mainly intended for production of food, stock enhancement and socio-economic development.

2 World evolution

Aquaculture has been growing at a rapid pace and is indeed one of the fastest growing food industries with a growth rate of around 10% per annum. According to FAO, it is reported that the total world fisheries production in 2005 amounted to 173 million metric tonnes, out of which the total capture fisheries amounted to 94.6 million metric tonnes and the total aquaculture production was 78.4 million metric tonnes. It is forecast that by 2010, the increase in the production of farmed fish in the world would surpass that of capture fisheries.

The demand for high value marine finfish is increasing and to meet the demand several countries in the Asian region (mainly China, Malaysia, Thailand, Vietnam, Indonesia), and Norway, Chile and Greece are involved in the farming of marine finfish. The annual production of farmed marine finfish in the Far East countries is estimated at around 550 000 metric tonnes and the bulk of the production (85%) comes from marine cage culture. More than fifty (50) species of fish are currently cultured (sea-bass, sea bream, groupers, red drum, cobia, amberjack, etc).

In Greece, there are about seventy (70) companies operating about two hundred and twenty (220) fish farm sites for the on-growing of sea bream and sea bass. The fish seed required for stocking is obtained from the wild, from local hatcheries or is imported. Chile has radically changed its focus from a very well developed fishing nation, to that of a 'top ten' world fish farmer that exported close to US\$ 1 550 million worth and 385 000 metric tonnes of aquaculture products during 2004, with a cultivated production of about 700 000 metric tonnes. Chile started salmon and trout culture only 20 years back and is presently the second only to Norway's aquaculture fish production and is likely to surpass the volumes harvested there.

At the present time, the feed used for rearing the fish is mainly trash fish. Although commercially formulated feeds for marine finfish have recently been developed, they are still not widely used. Culture with the use of these feeds promises better fish survival, improved feed conversion and higher cash returns. The problems faced in marine finfish farming among others are the limited supply of good quality seed, diseases caused by ectoparasites, bacteria and viruses, poor water quality and deterioration of the environment, and the rising cost and shortage of trash fish. Markets and marketing considerations are increasingly becoming the most important areas of concern to local firms involved in aquaculture. Scales of production and production technology must comply with the strictest export regulations, and costs and prices are very competitive for most species, on a worldwide basis. Value added products include fillets, fresh or frozen, readily packed for direct sales at supermarkets and other outlets.

The new concept of offshore fish farm system points toward a quantitative jump in the ability to safely and efficiently farm large volumes of different types of fish in the open sea, even in adverse weather conditions, including typhoon and hurricane environments. The offshore floating cage can be submerged more than 15m below the waterline, protecting the fish from surface waves and winds and may be installed in 200 m deep water.

3 Aquaculture research and development in Mauritius

Aquaculture practices in Mauritius date back to the French colonization period. Fingerlings of multiple species of marine fishes were collected from the lagoon and stocked in 'barachois' for fattening. Such type of farming is still practiced. Species such as couscous, tilapias, dame c  r  , black bass and gouramier were introduced in the early twenties. Certain introduced species have caused species displacement in our freshwater system.

3.1 Freshwater aquaculture

A camaron (freshwater prawn) brood stock was introduced in 1972 from Hawaii. The green water and the clear water rearing techniques were acquired and the technology was transferred to the private sector for commercial production. Hatchery production and grow-out were completely taken over by the private sector. However, in 2002 the private sector had to abandon the business because of high costs and water scarcity. The

Government hatchery took over to ensure production of juveniles to support medium and small scale farmers around the island.

In late 1975, three species of Chinese carps and three species of Indian carps were introduced for freshwater aquaculture. Induced spawning using hormone injection resulted in the production of fish fry for polyculture with camaron. The culture was undertaken on a commercial basis by the private sector for producing carps and camaron for sale. However, as consumer demand for carps was not high the culture was discontinued.

In 1990, the red tilapia hybrid was introduced from Malaysia. Monosex fish is produced through sex reversal treatment for culture yielding quality seeds with high growth and good survival rate. The culture techniques were adopted by the private sector and similarly as for the freshwater prawns, production ceased in 2002. The production of fingerlings by the Ministry was continued at the La Ferme Fish Farm for the benefit of small aquaculturists and fingerlings were initially distributed free of charge to encourage fish farming.

The culture of the freshwater crayfish introduced from Australia by the private sector in 1996 was discontinued due to a low consumer demand.

3.2 Marine aquaculture

In 1989 sea bream culture was initiated in collaboration with the Japanese International Cooperation Agency (JICA) for the production of seed for trial culture in barachois. Seed production techniques were mastered. Fingerlings were regularly released in the coastal waters for stock enhancement.

In 1987, the culture of two species of marine shrimps was undertaken with the assistance of JICA. The technology transfer to the private sector did not materialize due to high capital investment and unavailability of rearing space in the coastal areas. However, the Government hatchery continued production of shrimp juveniles to be stocked in barachois and to be released in the lagoon for stock enhancement. With a view to encourage culture of shrimps by inland farmers, trials have been conducted at the Albion Fisheries Research Centre recently to acclimatize the marine shrimps for growing in fresh

water. Results did not prove to be encouraging. Seed production of crab was also undertaken with assistance from JICA with no convincing results for mass culture

The floating cage culture was introduced only recently in 2002. The red drum, sea bream and rabbit fish were cultured by a private farmer in the deep channel in the lagoon of the south east coast of Mauritius with promising results.



4 On-going aquaculture activities

The culture of the freshwater prawn is undertaken by a number of small and medium scale farmers in fresh water and seeds are provided by the Government hatchery.

Two strains of tilapia hybrid, the berri rouge are also undertaken as backyard culture by small farmers. With the leasing of the La Ferme Fish Farm for private production of barramundi in 2006, production of berri rouge fingerlings is being undertaken in the ponds at the Albion Fisheries Research Centre to service local farmers with seeds.

A few barachois are involved in the culture of oyster, crabs, and marine fish from the wild and acclimatized berri rouge. Moreover, to enhance the fish stock of the lagoon, fingerlings of the seabream and juveniles of the marine shrimp are regularly released in the lagoon.

An in-depth survey on barachois was carried out by the Ministry of Housing and Lands and Ministry of Agro-Industry and Fisheries (Fisheries division) and a report on barachois management was published in 2006. The main recommendation formulated was the exploitation of barachois through IPD (Integrated Development Projects) and IRS (Integrated Resorts Scheme), which would include *inter alia* farming, water sports, eco-tourism and hotel development activities in barachois.

As mentioned earlier, a major aquaculture project in floating cages for the production of the red drum in association with other finfish is underway since 2002. The venture is expected to produce 1 000 tonnes of fish yearly, which will mainly be meant for the export market. The production of fish from cage culture was around 370 tonnes in 2006.

Experimental culture trials of two sea cucumber species were undertaken. The larval rearing technique has yet to be acquired.

5 Potential for sustainable aquaculture development in Mauritius

The potential to develop the aquaculture industry and substantially increase fish production and promote export and economic growth exists and it is believed that the technology undertaken for cage culture in the open seas overseas may be adapted to suit local conditions. Besides, the recently introduced cage culture in the lagoon areas has indicated that there is scope for increase in fish production. However, for successful cage culture of fish, a certain number of conditions should be satisfied such as sufficient water depths, adequate water current and water quality, protection from surf, legal framework, sufficient investment, suitable species and technology amongst others.

6 Aquaculture Master Plan

The Mauritian economy is facing major difficulties in its traditional textiles and sugar sectors, which make up the bulk of its export earnings. Faced with such difficulties on the economic front, the Government is actively encouraging the emergence of new growth sectors. The choice of marine aquaculture was dictated by the rapid pace of aquaculture development in the world on the one hand, and the untapped potential of Mauritius in finfish farming and marine aquaculture on the other. This potential has come to light after a successful attempt by the private sector to produce red drum, sea bream and rabbit fish in floating cages on a relatively large commercial scale.

In this context an aquaculture Master Plan was commissioned by the Board of Investment in 2006 to explore the potential of aquaculture in Mauritius. The output from the study should also serve as a marketing tool for the Board of Investment to sell Mauritius as a base for marine aquaculture projects to potential investors. Finally, it should serve as an eye-opener to interested investors or fishermen's associations, who may subsequently decide to carry out more detailed feasibility and invest in marine aquaculture projects of their choice.

The main objectives of the Plan were as follows:

- Identification of potential sites for aquaculture farming
- Identification of commercial species and technologies;
- Existing constraints which could be of a physical/technical, and legal; and,
- How to clear the ground for further investment in marine aquaculture projects.

The draft report of the Master Plan prepared by, IDEE, a French consultancy services was submitted in January 2007. A workshop to disseminate the main conclusions of the draft report and to finalise the Master Plan was organized on the 12th and 13th April 2007 that was attended by over 100 participants, both local and from abroad. The draft final report was received in May 2007 and the report was finalized in November 2007.

6.1 Potential sites identified for aquaculture development

Over 20 sites (figure 1) have been identified for the following four types of aquaculture:

- Lagoon aquaculture (phase one);
- Offshore aquaculture (phase two and three);
- Aquaculture in the coastal belt, including barachois (phase one); and,
- In-land aquaculture (phase one).

According to the Master Plan, offshore aquaculture, though used in the world since only a decade or so, is possible in Mauritius in the medium and long term.

The consultant has supported the policy for barachois development with small aquaculture projects coupled with eco tourism development in line with the report of the Fisheries Division of the Ministry of Agro Industry and Fisheries and the Ministry of Housing and Lands (2006) on management of barachois towards IDP and IRS development projects. The consultant has also proposed some sites for potential development of small/medium in-land aquaculture.

Figure 1: Potential Aquaculture Areas Identified



The Government plans to lease the sites identified to investors with sustainable, environmental-friendly aquaculture projects. The potential sites identified can be summarized as follows:

6.1.1 Sites identified for in-land aquaculture using sea water

1	Grande Baie de la Petite Rivière Noire	Semi industrial farming in concrete ponds
2	Les Salines	Industrial farming in concrete ponds (production of over 1,000t)
3	Tamarin	Semi industrial farming in concrete ponds
4	AFRC	Can produce juveniles for aquaculture farms.
5	Ville Valio	Industrial farming in concrete ponds (production of over 1,000t)
6	Pointe Oscome	Earth ponds farming

6.1.2 Sites identified for in-land aquaculture using fresh water

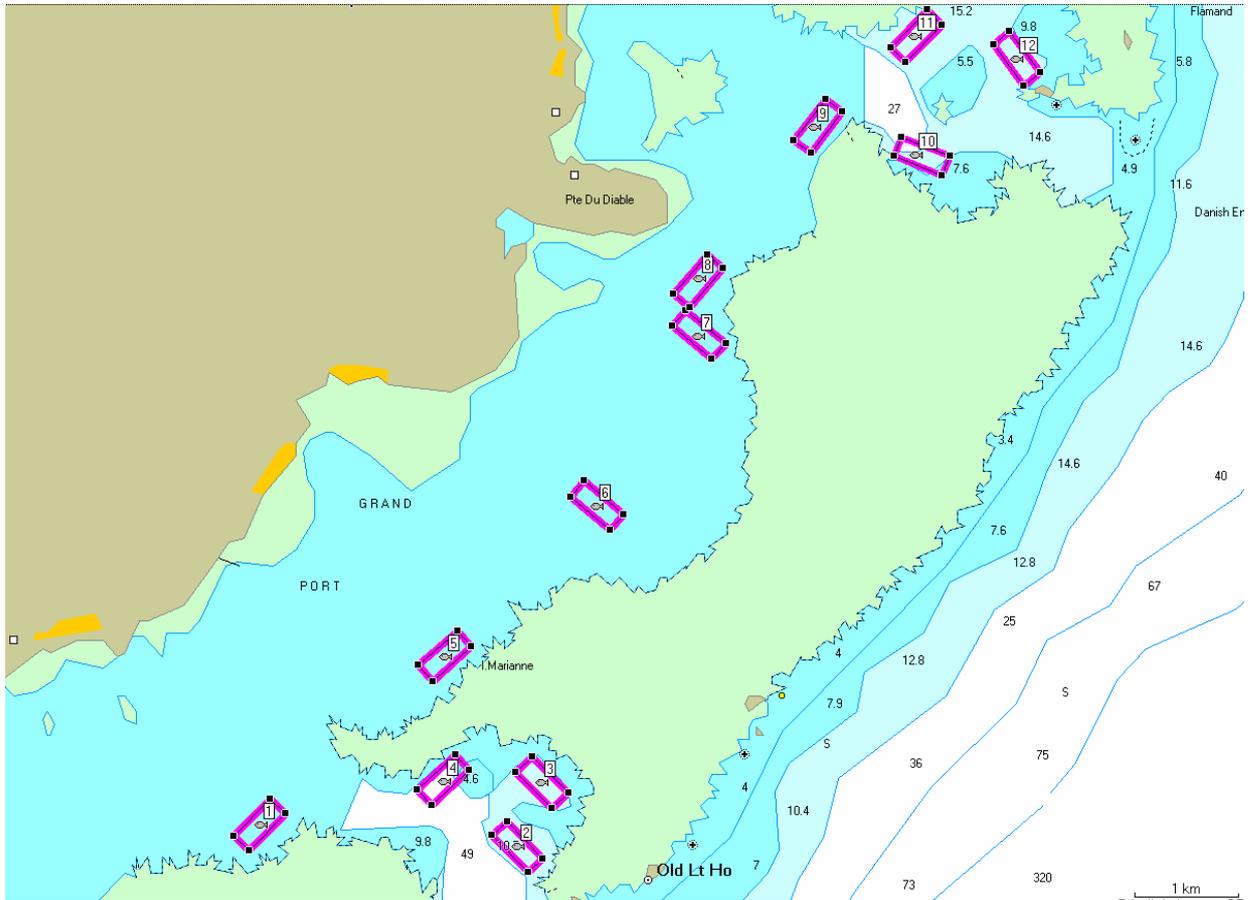
1	Le Val	Some 1,000 to 2,000 could be produced over a five-year period
2	La Ferme	

6.1.3 Sites identified in the lagoon of Mahebourg (Sea area of 200*500m or 10ha)

	Site Location	GPS Co-ordinates	Max depth	Observations
1	South West Olive Bank	S 20° 23' 38" E 57° 44' 05"	25 m	Weak current. Water particle-loaded. Silty. Site to be validated.
2	North East Pineapple Bank	S 20° 23' 32" E 57° 45' 52"	24 m	Well-protected site with weak current. Sand and silt mix but predominantly sandy.
3	Horseshoe Bay	S 20° 23' 13" E 57° 45' 56"	29 m	Excellent site with open-ocean influence. Sand and silt mix.
4	South Horseshoe Bank	S 20° 23' 32" E 57° 45' 52"	50 m	Relatively well-protected site with fair current throughout the entire depth. Sand and silt mix.
5	West Marianne Island	S 20° 22' 15" E 57° 45' 10"	26 m	Good current characteristics. Sandy, lightly silty.
6	North East Jonchée Bank	S 20° 21' 47" E 57° 46' 19"	23 m	Narrow site. Current characteristics subject to further study.
7	East Bambou Point (1)	S 20° 20' 54" E 57° 46' 32"	29 m	Vast site at the bank's edge with open-ocean influence. Sandy.
8	East Bambou Point (2)	S 20° 20' 25" E 57° 46' 28"	28 m	Adjacent to site 7. Sites 7 and 8 could be integrated into one project. Sand and silt mix.
9	West Reef Point	S 20° 19' 38" E 57° 47' 10"	25 m	Good current characteristics with strong open-ocean influence. Silty.
10	South Diamond Reef	S 20° 19' 51" E 57° 47' 48"	20 m	Surface swells. Sand and silt mix. Site accessibility subject to further study.
11	South Big Pass Point	S 20° 19' 15" E 57° 48' 09"	29 m	Good current characteristics. Sand and silt mix.
12	West Flammand Island	S 20° 19' 28" E 57° 48' 50"	30 m	Relatively open-ocean site. Surface swells. Sandy.

The 12 sites are geographically illustrated in the following diagram.

Figure 2: Potential sites identified in the Mabebourg lagoon



6.1.4 Offshore aquaculture areas identified

	Location	Area	Observations
1	Le Morne	1,250 ha	Some 10 farms of 50ha each can be implemented in the short term
2	Tamarin	420 ha	Some 15 farms of 50ha each can be developed in the medium term. A sea platform will be required for sites 4 and 5
3	Bambous	420 ha	
4	Trou aux Biches	480 ha	
5	Cap Malheureux	600 ha	
6	Coin de Mire		Several thousands of ha available in the long term

Nine barachois have also been identified for integrated development projects with an aquaculture component.

6.2 Production

According to the Plan, the overall annual production may reach 29,000t for all species combined in the short and medium term to culminate to 39,000t as follows:

- Lagoon 5 to 10,000 t/year
- Open sea 15,000t/yr
- Coastal belt 2,000 t/yr
- In-land fresh water 1 to 2,000 t/yr

6.3 Species recommended

The Consultant has mainly privileged species already under culture, namely red drum, cordonnier and barramundi. Cobia is another recommended species due to its fast growth. Except for cordonnier the other species namely red drum, cobia and barramundi fetch high price on the world market i.e. from 7 to 12 US\$ kg depending on types of product. The ranking of potential species as identified in the Plan are as follows:

<i>Rk</i>	<i>Species</i>	<i>Existing/to be imported</i>	<i>Technical know how</i>	<i>Market</i>	<i>Type of exploitation</i>
1	Red drum (<i>Sciaenops Ocellata</i>)	Already introduced locally	Well defined and mastered	Export	Industrial
2	Cobia (<i>Rachycentron Canadum</i>)	Already introduced locally	Well defined and recently mastered	High potential for export	Industrial
3	Nile Tilapia (<i>Oreochromis Niloticus</i>)	To be imported	Well defined and well mastered	Local, export possible	Industrial
4	Cordonnier (<i>Siganus Sutor</i>)	Already introduced locally	Well defined and being mastered	Middle East and high potential for EU	Industrial
5	Barramudi (<i>Lates Calcarifer</i>)	Already introduced locally in fresh water	Well defined and mastered	Asia, demand is increasing in other regions	Industrial
6	Shellfish (oysters & mussels)	Local species	Well defined and mastered	Local market	Small scale
7	Yellowtail Kingfish (<i>Seriola Lalandi</i>) & Almaco Jack (<i>Seriola Rivoliana</i>)	Local species	Well defined and being mastered	Export	Industrial
8	Sea cucumber	Local species	Well defined and being mastered	High demand in Asia	Small scale – stock enhancement

6.4 Production and Economic Analysis

- Lagoon Cage Culture
300/500 tonnes per production unit

- Earthen Pond Culture along or on coastal belt
300/500 tonnes per production unit

- Offshore Lagoon Cage Culture
2000 t per production unit

- Integrated Projects in barachois
No commercial production foreseen

- Shellfish Culture in specific regions around the coast (seashells, oysters, clams/mussels and sea cucumber) and aquarium fish – No figures provided.

6.5 Return on Investment

- Minimum investment: USD 0.8 million for a production farm of 500 tons
- Expected return on investment: 15% with a pay back period of 7 years

Interested investors are invited to contact us to further discuss the opportunity for them to invest in a sustainable environmental-friendly aquaculture projects in Mauritius

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