Potential for Mariculture in Jamaica

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INTRODUCTION

Aquaculture is the aquatic counterpart of agriculture and has been practiced in some eastern countries for at least three thousand years (Bardach *et al.*, 1972). Meske (1985) defines aquaculture as the husbandry, management, nutrition, and breeding of useful aquatic organisms for food or for profit. A wide range of organisms are used in aquaculture, including finfish, crustaceans, molluscs, and algae. Mariculture is the farming of organisms in the marine environment.

According to FAO (1989) world-wide annual fish production is currently about 92 million tonnes. Very little increase in production is expected from the marine capture fisheries because all the major fish stocks around the world are either fully exploited or are overexploited. The demand for fish for human consumption is growing much faster than the growth in production from the capture fishery. By the year 2000 Beveridge (1987) predicts that demand will exceed supply by approximately 40 million tonnes. It seems, therefore, that the only real hope of meeting this shortfall is to increase aquaculture production through the development and application of economically feasible scientific methods of aquaculture particularly in coastal waters.

AQUACULTURE IN JAMAICA

Aquaculture started in Jamaica in 1976 with the establishment of a project to investigate the feasibility of tilapia farming. Various red strain hybrid tilapia species, the silver perch (*Oreochromis niloticus*), and various species of carps, are grown under semi-intensive conditions in earthen ponds. The giant fresh water prawn (*Macrobrachium rosenbergii*) is also reared in Jamaica under semi-intensive conditions. Most of the fish and prawns produced by the local fish farmers are consumed locally.

Mariculture started in Jamaica in 1977 with a project to investigate the feasibility of culturing the mangrove oyster (*Crassostrea rhizophorae*). At present this is the only marine species cultured in Jamaica. The culture technique comprises a suspended rack system with a substrate consisting of bits of used motor vehicle tires suspended by lines from bamboo rafts. Naturally produced spats settle on the artificial substrate during the spawning season, and are allowed to grow for about eight weeks. At the end of this period they are transferred to rafts in deeper waters for a grow out phase lasting 4 – 5 months.

FACTORS AFFECTING MARICULTURE DEVELOPMENT IN JAMAICA

The suitability of Jamaica for mariculture depends to a great degree on the physical environment, the economic environment, and the socio-political environment.

The physical environment which affects the potential of the island for mariculture include the climate, water quality, exposure of the site to wind, waves and tidal currents, and the coastal configuration.

Jamaica is located approximately 145 km south of Cuba and 160 km west of Haiti (Figure 1). It has a tropical maritime climate which is modified by the Caribbean Current which flows from the equatorial Atlantic to the Caribbean Sea, and by the north-east trade winds. Sea temperature vary between 25.5 – 29.3 degrees centigrade (Munro and Thompson, 1983). The effect of tide is slight, the range varying between 20 – 36 cm on the coastline (NRCD and Fields Associates Inc., 1987). Primary production in the coastal waters is estimated to be in the range of 300 – 1000 $mg/m^2/day$ (Munro, 1983).

Jamaica has an irregular coastline which is about 850 km in length. It is punctuated by numerous coastal features such as harbors, bays, beaches, estuaries, mangrove swamps, rocky shores, cays, coral reefs, and lagoons (Figure 2). These natural features provide a coastal resource base that contributes significantly to the economic well-being of the country. In general the south shoreline is edged by mangrove swamps, herbaceous wetlands, black sand beaches, and long straight cliffs. The north shoreline on the other hand is characterized by white sand beaches and sea cliffs (NRCD and Fields Associates Inc., 1987).

The coastline is fringed by an insular shelf which is relatively narrow around most of the island. Beyond the 40 m contour, the seafloor quickly drops to depths ranging from 2,000 m to 10,000 m. On the south coast the shelf extends to approximately 38 km, whereas it does not extend more than 4 km anywhere along the north coast. The north coast is characterized by well developed patches of corals, sea grass beds, and sandy patches (NRCD and Fields Associates Inc., 1987).

Wind speeds exceeding 15 m/s with associated choppy seas are common (Munro and Thompson, 1983). There is a hurricane season in the Caribbean from July to October each year during which violent storms may occur. These usually cause damage from the intense rain, high winds, and waves. This is a disadvantage for mariculture development in Jamaica.

Jamaica has a resident population of 2.3 million and over 1 million tourist per annum or approximately 14,000 visitors at any one time (PIOJ, 1987). The present demand for fish and fish products is approximately 27,000 t per annum and far exceeds the available supply (Ministry of Agriculture, 1988). Aquaculture has grown rapidly since 1976 and by 1988 was producing approximately 3,000 t of fish (Ministry of Agriculture, 1989). The remaining

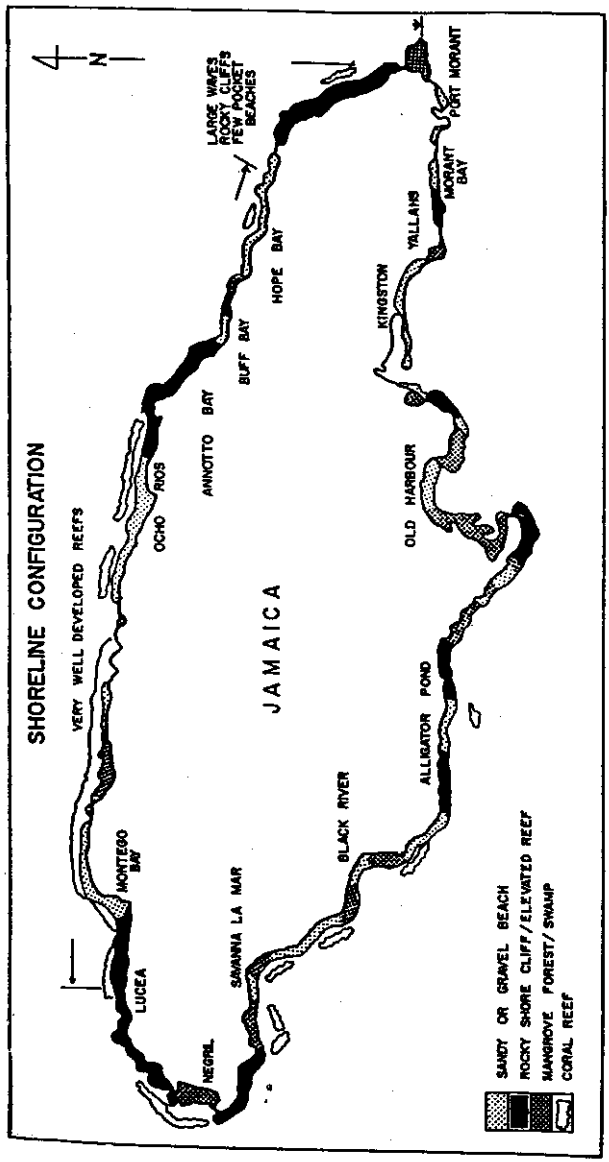

Figure 1. Map of Jamaica placing it in a regional context (NRCD and Fields Associates, Inc., 1987).

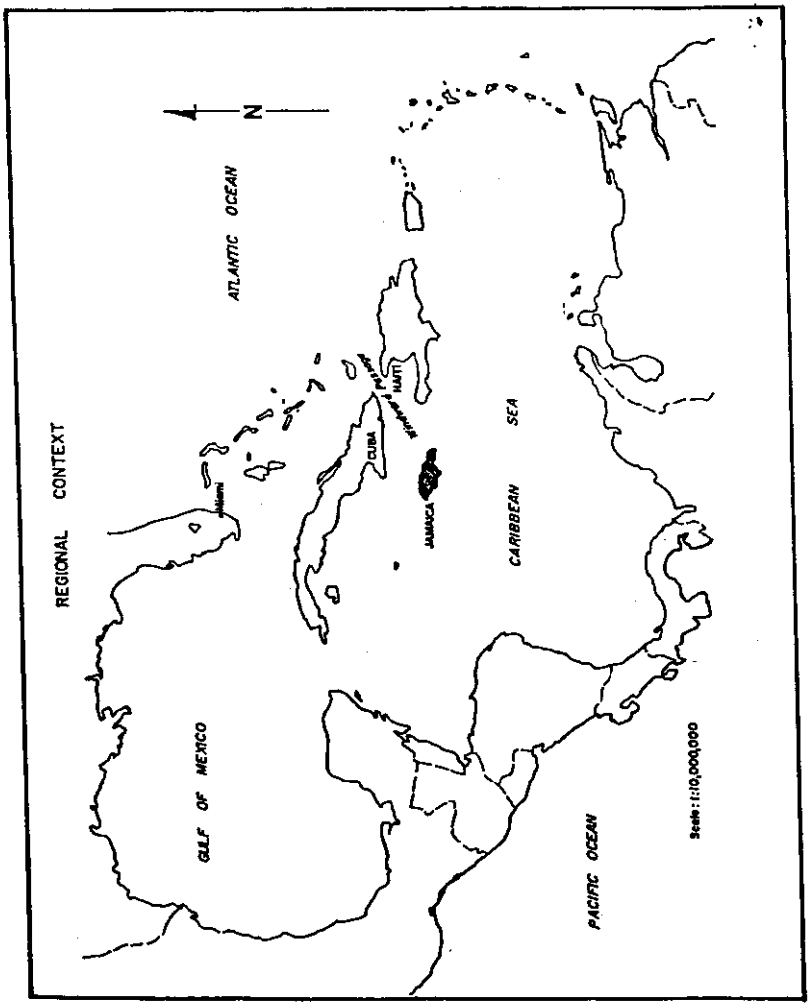

Figure 2. Jamaica's shoreline configuration (NRCD and Fields Associates, Inc., 1987).

in Jamaica would be most practicable using technology that is already developed and proven. This would however, require a period of introduction involving feasibility investigations and pilot projects during which the technology is transferred and modified to suit the environmental and socio-economic conditions of Jamaica.

In selecting the species for mariculture, careful consideration should be given before non-native or imported species are introduced because of the potential of introducing new diseases and of changing the existing ecosystem (Sleeter, 1984). Introduction of imported species are permitted in Jamaica subject to the discretion of the Fisheries Department. All the species used for fresh water fish farming in Jamaica are imported species. The advantages of using imported species include the ability to select species with very high market acceptance, and, the fact that most species of commercial value already have a large data base concerning their biology and methods of rearing (Sleeter, 1984). Growing such species would therefore not require the development of new technology.

Oyster farming has already been established in Jamaica with the cultivation of the mangrove oyster (*C. rhizophorae*). Another indigenous species, the flat oyster (*Isognomon alatus*) is also accepted by the local market and may have potential for mariculture.

Imported species that may be considered for farming in Jamaica include the American oyster (*Crassostrea virginica*), *C. gigas*, and the European oyster (*Ostrea edulis*) which are farmed commercially in many areas. These oysters command fairly high prices in Europe and North America (Chanley *et.al.*, 1984). Although the European oyster is considered a cold water species, it has been successfully cultured in the Virgin Islands (Chanley *et.al.*, 1984) where the temperatures is comparable to that in Jamaica.

The queen conch, *Strombus gigas*, is a gastropod mollusc which has a very high market price in North America and the Caribbean. It has been successfully cultured under experimental conditions in the United States and in the Caribbean (Davis and Dalton, 1991; Creswell, 1984; Hensen, 1991). The farming techniques used in these areas could be refined and adapted for the Jamaican environment.

Penaeid shrimp are very attractive for farming because of the world-wide market and high price. Penaeid shrimp farming is popular in Southeast Asia and Latin America. Several species are cultured including *Penaeus monodon*, *P. indicus*, *P. japonicus*, *P. stylirostris*, and *P. vannamei* (Milne, 1979). McSweeny (1984) recommended *P. stylirostris* as the most suitable species for intensive farming, and *P. vannamei* and *P. monodon* for pond farming in Bermuda. These and other local species such as *P. braziliensis*, *P. notialis*, and *P. schmitti* may have commercial mariculture potential in Jamaica.

Facilities for lobster culture are located in several countries including the

United States, France, Norway, Canada, Japan, and several other countries. The technology for lobster farming on a commercial scale has not yet been perfected. Nevertheless several international companies are actively looking at the possibility of raising lobster commercially in the near future.

The dolphin-fish (*Coryphaena hippurus*) has been successfully reared from juvenile to adult size in floating cages with high growth rates. The adults have also been successfully spawned in captivity, and methods of growing the larvae developed (Glude, 1984). Good markets for the dolphin-fish exist in the United States and in the Caribbean. Commercial farming should therefore be practicable in the near future (Glude, 1984). The coastal waters of Jamaica appear to be suitable for dolphin-fish farming.

There are very good markets for groupers (genus *Epinephelus* and snappers (family Lutjanidae) in the United States, Canada, and in the Caribbean. Some species of the genus *Epinephelus* have been reared in floating net cages and enclosures in Hong Kong, Singapore, Japan, and Indonesia (Glude, 1984). Various *Epinephelus* species occur in the coastal waters of Jamaica and in the Caribbean Basin. Research is currently being conducted in the culture of snapper and grouper found in this region and it appears likely that in the near future shallow water species such as the yellowtail snapper and grey snapper and the Nassau grouper might be raised in floating cages or fenced enclosures.

The red drum (*Sciaenops ocellatus*) has been cultured experimentally in Florida. The culture methodology, market potential, and site locations have been reviewed by Roberts (1991). There seems to be significant potential for the culture of this species in the coastal waters of Jamaica.

Various species of perch including the Florida red tilapia hybrid (*Oreochromis urolepis hornorum* female x *O. mossambicus* male) and *Seratrerodon mossambicus* have been successfully cultured in sea water in the Caribbean and Florida (Rust *et al.*, 1991; Brass *et al.*, 1991; Watanabe *et al.*, 1991; Glude, 1984). There appears to be substantial potential for development of marine farming of tilapia in Jamaica.

Seaweed has been cultivated for a long time particularly in the Far East where red algae (*Porphyra*), green algae (*Monostroma*), and the brown algae (*Laminaria* and *Undaria*) are produced (Meske, 1985). The "sea moss" (*Gracilaria*) is cultured commercially on the Caribbean Island of St. Lucia. The environmental conditions of St. Lucia are similar to that of Jamaica, and furthermore there is a very good market for *Gracilaria* in Jamaica where it is considered an aphrodisiac. *Gracilaria* therefore, seems to have excellent potential for mariculture in Jamaica.

DISCUSSION

The prospects for mariculture in Jamaica looks good. There are several shallow, sheltered, bays and inlets along the coast that appear to be suitable for

mariculture. Most of the north coast, where there are several white sand beaches and well developed coral reefs, have been developed for recreation and tourism. Accordingly, the shallow coastal waters of the south coast, which has many sheltered bays and inlets, and suitable climatological and hydrological features provide the most suitable sites for mariculture. Landings from the capture fisheries have remained static since 1968 despite a doubling of the fishing effort (Aiken and Haughton, 1987). The expansion of fresh water fish farming is constrained by the limited amount of suitable land space available for pond construction, and the limited amount of fresh water available. The development of mariculture, therefore, holds real possibilities for increasing fish production, providing employment, reducing foreign exchange expenditure by import substitution, and also earning foreign exchange by exporting to hard currency markets in Europe and North America.

Prior to the establishment of a commercial marine farming venture, however, it is essential to carry out further analysis of the hydrology and hydrography of the site to ensure satisfactory condition for the farmed species.

There are a number of species that look promising, including groupers, dolphin-fish, red drum, red hybrid tilapia, penaeid shrimp, queen conch, oyster, and "sea moss." Considering the economic and social conditions, it is prudent for the strategy for mariculture development in Jamaica to be two fold, the provision of a cheap source of protein and employment for the masses, and the provision of exotic (high priced) species for export and for the tourist trade. Although there are potential problems associated with the introduction of imported (exotic) species, consideration should be given to the farming of those species that have excellent market potential, especially for export to hard currency markets. The risks involved in the introduction of new species can be minimized by strict adherence to the I.C.E.S. (International Council for the Exploration of the Seas) recommendations for imported species (Sleeter, 1984).

The Jamaican Government should encourage mariculture development by initiating feasibility studies and pilot projects to transfer and modify the technology, and assess the viability of such ventures. The technology is largely proven elsewhere and would only need minor adjustment in Jamaica.

Careful attention should be given to the various groups using the coastal waters which are likely to be affected by mariculture, particularly the local fishermen. Some fishermen could be encouraged to become fish farmers thus, reducing the fishing effort in the overexploited coastal fisheries. Every effort should be made to integrate the local communities into mariculture operations.

Although there are several constraints to the development of mariculture in Jamaica, they are not insurmountable, and with the rapidly increasing volume of information on mariculture the potential for developing economically successful operations in Jamaica looks good. The risk from hurricanes is a major concern, but can be minimized by careful selection of the site, designing of the rearing

system (*e.g.* cages), and construction of special protective barriers (*e.g.* breakwaters).

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