Marshall Islands Ocean Development, Inc. (MIOD) is a partnership between a Taiwanese company and local partners. It received approval for a Foreign Fishing Agreement in January 1997. The company was originally established as a tuna longlining operation to be based in Majuro, and installed fish handling and freezing equipment in a building adjacent to MIMRA. It was granted 10 longlining licences and was going to airfreight to Japan as well as loin the catch. For unknown reasons this did not eventuate and the company applied for an experimental live fish agreement. The current operation has been fishing Mili, Arno, Aur and Majuro. The company is chartering its vessel from the Taiwanese owners. This vessel, the *Lien Fu Tsai No. 2* (CT4-2131), is a fish carrier/longliner built in 1991 with a gross tonnage of 99.8 t, a length of 18.95 m, an engine capacity of 750 hp, a fuel capacity of 78,122 l, a speed of 11 knots, and a crew of up to 23. (*Note: On June 13, 1997, the FSS* Micronesia *(FSM patrol boat) arrested the* Lien Fu Tsai No. 2 *for illegally fishing in the Yap State Fishing Zone, while en route from Majuro to Taiwan for maintenance*.).

The live reef fishing operations in RMI are still in the experimental/trial stage, according to the MIMRA Director, and management and enforcement mechanisms are being developed as more experience is being gained in this form of fishery. The RMI Environmental Protection Authority is currently working with MIMRA and the International Marinelife Alliance–Philippines (IMA) to sample and test fish caught for traces of cyanide. IMA is a non-profit organisation based in Manila that has a contract with the Philippine government to test live reef fish for cyanide. It has offered to assist RMI in testing its samples.

Grouper aquaculture in Australia

by M. Rimmer [1], *M. O'Sullivan* [2], *J. Gillespie* [3], *C. Young* [4], *A. Hinton* [5] *& J. Rhodes* [6]

Abstract

Australia has an established wild capture fishery for grouper species in northern Australia. The major fishery is in Queensland, where the reef line fishery targets coral trout (*Plectropomus* spp.). The current commercial catch is estimated at about 1,200 t/yr with an additional 1,100 t caught by the recreational sector. In 1994, about 43 t of the commercial catch was exported as live product, most of which was air freighted to Hong Kong. Higher-valued species (barramundi cod (*Cromileptes altivelis*) and Maori wrasse (*Cheilinus undulatus*)), are uncommon.

Grouper aquaculture has only recently commenced in Australia, with two commercial hatcheries and one government hatchery commencing research on estuary cod (*Epinephelus coioides*) and barramundi cod. To date, no significant commercial production has been achieved. Because of the developing market for high-value live reef fish in South-East Asia, there is increasing interest in aquaculture of reef fish species, particularly groupers.

A feasibility study was carried out by the Queensland Department of Primary Industries (DPI) during 1995–96 to assess the potential to develop a reef fish aquaculture industry in Queensland to supply the high-priced live fish markets in Hong Kong and China. The overall plan for the feasibility study is shown in Figure 1 (see next page). A series of seven studies was carried out:

1. Present and future markets for selected live reef fish in Hong Kong and China;

2. Queensland's current reef line fishery and its potential to supply live fish, particularly coral trout;

3. Case studies of similar projects worldwide including time taken, development costs and difficulties;

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4. Infrastructure required to service a live fish export industry;

5. Identification of sites suitable for land and sea cage-farming operations on the east coast of Queensland;

6. Detailed analysis of R&D requirements, and costing for a research programme to develop aquaculture techniques for high-value reef fish species;

7. Benefit / cost analysis of the R&D and subsequent commercial industry; and a financial evaluation to indicate the likely profitability of commercial farms that would commercialise the R&D output through live fish production and export sales.

Results of these studies are summarised in this paper. Because of the high cost of the proposed research, DPI is now assessing possible development of a joint government / private industry research project, as well as participation in collaborative research within the region. The Queensland Government has recently provided core funding to begin research into grouper aquaculture.

Introduction

Finfish aquaculture in tropical northern Australia is currently based almost entirely on production of barramundi (*Lates calcarifer*). Production of farmed barramundi has increased steadily since the late 1980s and 1995–96 production was about 460 t, valued at AU$ 4.9 million. Based on this success, the Australian tropical finfish aquaculture industry is keen to diversify by producing other finfish species, including snappers (Family Lutjanidae) and groupers (Family Serranidae).

Grouper aquaculture is currently only in the experimental stage in Australia. There are currently two commercial hatcheries that are undertaking research on the development of aquaculture techniques for estuary cod (*Epinephelus coioides*), one in Queensland and one in Western Australia. Commercial production of this species has not yet been achieved. Both these hatcheries are working in conjunction with Queensland Department of Primary Industries (DPI) aquaculture researchers. DPI researchers at Northern Fisheries Centre (NFC), Cairns, have previously undertaken research on common coral trout (*Plectropomus leopardus*) with reference to the development of aquaculture techniques for this species (Rimmer et al., 1994). More recently, we have commenced research on the development of aquaculture techniques for estuary cod and barramundi cod (*Cromileptes altivelis*) at NFC.

Queensland has recently seen the development of a fishery based on the capture and live export of reef fish species, principally the coral trout species (*Plectropomus* spp.). Because of the high wholesale prices paid for live reef fish in Hong Kong (see below), and concerns regarding the long-term sustainability of the capture fishery for live reef fish,

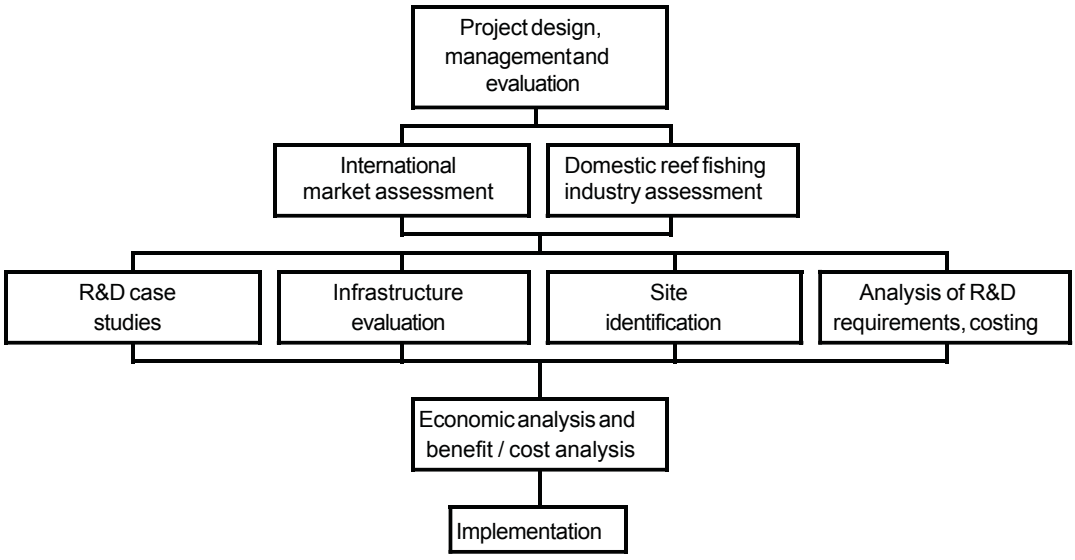

Figure 1

Network outline for studies carried out for the Reef Fish Aquaculture Feasibility Study

there is substantial interest in the development of an aquaculture industry for high-value reef fish destined for the live markets in Hong Kong and southern China.

In response to this interest, DPI undertook a feasibility study into the possible development of a reef fish aquaculture industry in Queensland. The overall objectives of the study were to determine what level of research and development (R&D) was likely to be required to develop a reef fish aquaculture industry, and whether the resulting industry was likely to be profitable enough to justify the costs of R&D to Queensland. Further details of this study are reported in the following section of this paper.

Reef Fish Aquaculture Feasibility Study

The Reef Fish Aquaculture Feasibility Study comprised seven individual studies which were undertaken by DPI staff, or by consultants in close collaboration with DPI staff. The overall study attempted to look at all aspects of R&D, production and marketing of high-value reef fish species specifically produced for sale in live markets in Hong Kong and southern China.

Market analysis

A market analysis was carried out by Hong-Kong based consultants, concentrating on the Hong Kong/southern China live marine finfish market. The total seafood market in Hong Kong is over 220,000 t/yr, and the current market for high-quality live reef fish is estimated to be 1,600–1,700 t/yr. Assuming that the Hong Kong and Chinese economies continue to expand at the current rate, both demand and price will expand in the immediate future. Compound growth rates in excess of 12 per cent are forecast, indicating that the market is expected to double every 6 years.

The demand for the highest-priced species, i.e. coral trout, barramundi cod and maori wrasse (*Cheilinus undulatus*), is currently only about 814 t. The average wholesale price (i.e. the price received by wholesalers from the restaurant trade) in 1995 for coral trout was AU$ 46/kg and for barramundi cod and maori wrasse was AU$ 87/kg.

Prices are forecast to be 60–100 per cent higher by the year 2003. The estimated wholesale market value for the top three species is projected to be AU$ 198 million in the year 2000, growing to AU$ 398 million by 2003. In addition to the market for live reef fish, there are substantial markets for whole, fresh-chilled product, although the extent of these markets was not investigated in this study. Existing supply sources are expected to be insufficient to satisfy projected demand. Wild stocks of finfish targeted for Asian live fish markets are reported to be severely depleted from overfishing and the use of unsustainable fishing practices, such as the use of cyanide (Johannes & Riepen, 1995).

Domestic reef fishing industry assessment

A desk-top study was undertaken to examine the capacity of the Queensland fishing industry for live reef fish to satisfy projected market requirements. This study used commercial catch records since 1989 and available research / management reports for the commercial sector of the reef line fishery to assess the capacity of this fishery sector to meet current and future market requirements.

The Queensland Reef Line Fishery is defined as all fishing that takes reef fish by handline, rod and line or troll line within the Great Barrier Reef Marine Park, which extends between the latitudes of 10° 41'S and 24°S on the continental shelf of north-eastern Australia. The fishery is divided into two main sectors: commercial and recreational. Fishing charter-boat operations are included in the recreational sector.

The combined annual commercial and recreational reef fish catch in this area is in the region of 8,000 t, of which coral trout and red throat emperor (*Lethrinus miniatus*) probably comprise as much as 2,300 and 1,000 t respectively (Brown et al., 1994). In the future, an increasing resource allocation problem is expected, due to the combined pressure of both recreational and commercial fishers, particularly near population centres.

The commercial sector of the reef line fishery is spread along the entire length of the reef system, with a concentration of catches and effort along the southern section of the reef, between Cardwell and Shoalwater Bay. Since it commenced in the 1930s there has been little change in the fishing methods used in this fishery. It is a hook-and-line fishery with recreational and commercial demersal reef fishers using very similar techniques and equipment. The fishery has a high level of latent effort. Although there are over 1,900 line-endorsed vessels, in 1994 50 per cent of the commercial coral trout catch was landed by only 30 commercial line-fishing vessels.

The demersal reef fish catch of commercial fishing vessels is about 1,600 to 2,400 t/yr (Table 1) and consists mainly of coral trout (59%). The value of this catch is estimated to be AU$ 6–10 million. Since 1989 commercial coral trout catches have varied between roughly 900 and 1,500 t/yr In 1994 1,100 t of coral trout were landed by commercial

Table 1: **Commercial catches (t) of coral trout (*Plectropomus* spp.), red throat emperor (*Lethrinus miniatus*), other demersal fish species, and total catch for the Queensland reef line fishery from 1989 to 1994**

Year	Coral trout	Red throat emperor	Other	Total catch
1989	930	419	298	1,646
1990	1,254	479	381	2,113
1991	1,427	516	387	2,329
1992	1,467	548	318	2,332
1993	1,260	538	240	2,038
1994	1,100	514	235	1,850

operators and an estimated 43 t of this catch were exported as live fish. There is significant spatial variation in coral trout catches, with the bulk of commercial catches of coral trout coming from the reefs south of Cardwell to Shoalwater Bay (latitudes 18°–22°S). Catches, effort and catch rates increase from a low in January each year to a high between September and November, which is the spawning period for coral trout. There have been industry suggestions that a fishery closure during the spawning season would assist in conserving coral trout stocks.

Although in the past virtually all captured coral trout were utilised in the domestic retail and restaurant markets, export of live reef fish is a rapidly growing component of the Queensland reef line fishery. According to Australian Quarantine Inspection Service records, 42.5 t of live fish were exported from north Queensland in 1994 and the Queensland Fisheries Management Authority reports that 47 t were exported in the first six months of 1995. Approximately 90 per cent of the fish exported are coral trout, 4 per cent are barramundi cod and a mixture of other reef species make up the remainder. Retaining live fish for export has been estimated to provide fishers with an increase in profit of around 30 per cent.

The stocks of coral trout on the Queensland east coast appear to be fully exploited due to the combined pressure of both recreational and commercial fishing. If the whole commercial reef line fishery converted from fillet product to live fish operations, it could potentially supply up 700 t of coral trout annually, which is a significant increase from the present 50–100 t. However, due to size and colour preferences, not all of this catch is suitable for the Hong Kong market.

There is considerable opposition to live reef fish exports from the recreational and fishing charter sectors of the community. This opposition is based on the perceptions that the live fish export industry is causing overfishing, is targeting small fish and is limiting supplies of reef fish that should be freely available for other fishers to catch and consume. Aquaculture of reef fish species could offer solutions to these problems by providing an adequate supply of suitable fish without affecting the reef fish wildstocks. This would help to protect the reef fish stocks from overfishing while allowing expansion of the live export industry.

Research and development case studies

The costs of R&D for established aquaculture industries were investigated for six different finfish species: Atlantic salmon, channel catfish, barramundi, European sea bass and European sea bream. The halibut industry was also included in the report as an example of an industry that has recently commenced commercial production following an extensive period of R&D, but that still has relatively low production. Costs were estimated for the 'set-up' phase of each industry, i.e. the time from commencement of research to the establishment of a viable commercial industry. Various experts from research and development institutions associated with each industry provided information on establishment costs and time for each industry investigated.

Costs of initial R&D for the establishment of commercially viable aquaculture industries were generally in the range AU$ 70–90 million, in cases where there was no or little existing technology base for these industries. In cases where there was an existing technology base, initial

Table 2: **R&D costs for finfish aquaculture industries, with duration of start-up R&D phase in brackets; and 1993/94 production quantity and industry value. N/A: denotes no information available and '–' not yet producing.**

Fishery	Country / region	R&D (AU$)	1993–94 industry production (t)	Value (AU$)
Atlantic salmon	Norway	90 million (8 yrs)	207,000	900.0 million
	Scotland	26.5 million (18 yrs)	65,000	520.0 million
	Canada	6.5 million (3 yrs)	13,500	132.0 million
	Australia	3.7 million (6 yrs)	4,000	48.0 million
Channel catfish	USA	70.2 million (15 yrs)	132,000	441.0 million
Barramundi	Australia	2.5 million (5 yrs)	350	4.0 million
European sea bass	Mediterranean	N/A	14,000	152.2 million
European sea bream	Mediterranean	N/A	14,000	139.6 million
Halibut	Norway	67.5 million (20 yrs)	100	1.6 million
	UK	3–5 million (15 yrs)	–	–

R&D costs were substantially less, generally in the range AU$ 2.5–26.5 million (Table 2).

The value of these industries is roughly proportional to the level of R&D funding provided for their establishment. For example, the Norwegian Atlantic salmon industry cost AU$ 90 million over 8 years and is now valued at AU$ 900 million p.a., and the channel catfish industry in the US cost about AU$ 70 million for initial R&D and is currently valued at about AU$ 441 million p.a. (Table 2).

Other factors that this study identified as being of importance in the development of viable aquaculture industries are:

- R&D funding is generally provided by government bodies, and by industry-based organisations. Initial funding is primarily provided by government, with industry picking up R&D costs as production commences and the industry becomes profitable;

- A wide range of R&D areas (e.g. water quality, production technology, fish health, engineering, environmental issues, breeding, and larviculture) needs to be incorporated in the R&D studies.

Infrastructure requirements

A study was undertaken to assess the requirements for infrastructure to support export of live reef fish produced by aquaculture. The study found that the infrastructure to handle holding, packaging and export of live fish is in place to support the existing export of wild-caught fish. Although air-freight may be limited during some periods of the year, overall the availability of air freight space is not expected to be a limiting factor in the development of a reef fish aquaculture industry.

Recently, the ban on imports of live seafood containers using oxygen into Hong Kong has decreased the profitability of live fish export operations, and has led to renewed interest in alternative packaging technology. It was suggested that fast sea freight will provide a more cost-effective method of transport of live fish to Asian markets.

Reef fish grow-out site identification and evaluation

A constraint on the development of a reef fish aquaculture industry in Queensland is the availability of suitable sites, and the impact that aquaculture would have on the natural environment. Most areas suitable for grow-out of reef fish would be in, or would potentially affect, the Great Barrier Reef Marine Park. This is a World Heritage listed area that is internationally renowned for its relatively undeveloped coral reef environment.

A desk-based study was undertaken by consultants to identify potentially suitable sites for grow-out of reef fish species on the eastern coast of Queensland. Areas zoned as having high conservation value were excluded from consideration.

The study identified areas suitable for cage culture and additional sites potentially suitable for land-based culture. Because of the limited nature of the study, it is likely that there are additional sites that are suitable for reef fish aquaculture that were not identified in the present study. This is particularly the case for land-based sites. Additional land based sites may be utilised if recirculating production systems are used to grow out reef fish species.

R&D requirements and costing

A major constraint to the development of a reef fish aquaculture industry in Queensland is the technical difficulty in rearing large numbers of reef fish fingerlings for grow-out. Currently, survival of reef fish larvae to fingerling stage is low (generally <5% and often <1%). A review of the scientific literature was undertaken to identify the main technical constraints in reef fish aquaculture.

Although a range of reef fish species is cultured in other parts of the world, in general the success of these operations is low and many culture operations rely on the capture of juvenile fish from the wild for grow-out operations. Such operations are not regarded as ecologically sustainable and are discouraged in Australia for this reason.

In Australia today, a viable aquaculture industry must be able to:

- produce marketable product cost-effectively, by rearing animals through to harvest size from captive broodstock, and
- do so while maintaining minimal or negligible environmental impacts.

The following discussion of research and development (R&D) requirements for a reef fish aquaculture industry is based on these two important factors.

Queensland has a useful model for the development of a finfish aquaculture industry in the barramundi industry. The development of this industry has been supported by research carried out by the DPI. The progress of barramundi aquaculture in Queensland has shown that the development of a viable, relatively large-scale industry is dependent on:

- a reliable supply of high-quality larvae from captive broodstock;
- cost-effective larval rearing techniques;
- nursery and grow-out techniques that maximise survival and minimise production costs;
- existing markets for aquaculture product, and a marketing strategy for increasing production.

DPI's extensive experience in developing techniques that are now in use by the barramundi aquaculture industry has been used in determining the R&D needs for the development of a reef fish aquaculture industry.

Species selection

The discussion of R&D requirements focuses on coral trout and barramundi cod as the species of principal interest for reef fish aquaculture. However, a wider scan of species suitable for reef fish aquaculture was undertaken in order to avoid limiting species consideration at this early stage.

Several *Epinephelus* species were considered because there is an abundant literature on this genus, and because much of the information regarding *Epinephelus* culture is directly relevant to the closely related coral trout and barramundi cod. In addition, there is a significant body of opinion that *Epinephelus* species could support an aquaculture industry component in their own right. Assuming that technological advances allow routine and inexpensive larviculture, the farm gate production costs could be similar to those currently achieved on Australian barramundi farms.

Species considered in this study were:

Coral trout

Plectropomus leopardus	Common coral trout
Plectropomus laevis	Blue-spot trout
Plectropomus maculatus	Barred-cheek coral trout
Plectropomus areolatus	Passionfruit coral trout

Cod

Epinephelus coioides	Estuary cod
Epinephelus tauvina	Gold-spot cod
Epinephelus malabaricus	Black-spot cod
Epinephelus fuscoguttatus	Flowery cod

Barramundi cod
Cromileptes altivelis

Wrasse

Cheilinus undulatus	Humphead Maori wrasse

Critical aspects of R&D, identified by this study, were:

- maintenance of captive broodstock and development of captive breeding procedures;
- identification of live prey organisms suitable for use in larval rearing;

Table 3: **Proposed R&D programme for the development of reef fish aquaculture in Queensland**

	Duration	Main aims
Phase 1	4 years	Establish captive broodstock of at least 3 species. Develop spawning techniques for these 3 species. Undertake initial feeding and larval rearing trials. Develop culture techniques for copepods and other zooplankton prey.
Phase 2	3 years	Develop 'on demand' spawning techniques for the 3 fish species used in Phase 1. Commence development of spawning techniques for at least 1 additional species. Refine zooplankton production techniques. Develop reliable larval rearing techniques.
Phase 3	3 years	Refine spawning and larval rearing techniques. If possible, expand to other species. Undertake grow-out trials in conjunction with industry.

Table 4: **Summary of indicative funding for an R&D programme to develop reef fish aquaculture in Queensland**

Component	Phase 1 Years 1–4	Phase 2 Years 5–7	Phase 3 Years 8–10
Broodstock	965,000	642,000	497,000
Larviculture	973,000	728,000	725,000
Live food	1,868,000	1,318,000	1,240,000
Grow-out	1,450,000	921,000	980,000
Administration	984,000	421,000	417,000
Total (AU$)	**6,240,000**	**4,030,000**	**3,859,000**

- development of culture techniques for selected live prey organisms;
- development of larval rearing techniques;
- development of culture systems that provide for minimal environmental impact in the Great Barrier Reef Marine Park and adjacent waters.

Central to the R&D requirements for reef-fish aquaculture is the provision of high-quality reef water. A number of possible sites for the R&D programme are briefly discussed in the report, based on their access to water of suitable quality and their proximity to existing research facilities.

The R&D programme has been planned for a period of 10 years, split into 3 phases of 4, 3 and 3 years duration respectively (Table 3).

Continued funding of the later phases of the project would be contingent on achieving the milestones established for the previous phase. The indicative funding for the proposal totals around AU$ 14 million (Table 4).

The proposed R&D programme was designed to reduce the risk of not achieving the desired outcomes by investigating several reef fish species simultaneously, and selecting those that had the greatest potential for aquaculture.

However, it should be emphasised that even incorporating this strategy, and with the costly R&D programme outlined above, the development of reef fish aquaculture techniques should be considered a high-risk project.

An alternative strategy to the full R&D proposal costed in the report is the establishment of a smaller research effort, carried out in conjunction with overseas research organisations, mainly in South-East Asia. This has the following advantages:

- utilisation of existing expertise from these countries;
- lower R&D costs to any one participating country;
- reduced overall risk due to wider participation in R&D activities.

However, adoption of this option may reduce Queensland's competitive advantage in producing fish for live fish markets in the future.

Benefit/cost analysis and financial evaluation

A benefit/cost analysis was performed to indicate whether the substantial expenditure required to develop a reef fish aquaculture industry would result in positive economic returns for Queensland.

The benefit/cost analysis model used was based on the Grains Research and Development Corporation procedure (GRDC 1992) and required an estimate of the success of the R&D programme for each species.

Although it is difficult to predict the eventual success of culture of reef fish species, particularly in view of the paucity of biological information on most species and the high variability of survival found by other aquaculture researchers, the following probabilities were used for the benefit/cost analysis:

- coral trout: 20.0 per cent,
- Maori wrasse: 7.5 per cent,
- barramundi cod: 15.0 per cent.

It is considered that these figure are conservative, and that more accurate estimates of the probability of success can only be achieved following further research into aquaculture techniques for these species.

Other assumptions used in these models were:

- the R&D programme outlined above is successful, particularly with the extremely high-valued species such as barramundi cod;
- high market prices are maintained, as indicated in the marketing study, although prices were assumed not to increase past year 2000 forecasts because of increased supply from aquaculture;
- market demand continues to grow due to population increase and increasing affluence in China and Hong Kong;
- industry adoption commences in the tenth year of research and builds up to an industry with a production level of 2,500 t after 10 years and 7,000 t after 20 years;
- fish reach a preferred market weight of 1 kg after a grow-out period of 24 months.

Epinephelus species were not considered in the benefit/cost study or the financial evaluation. The relatively low value of these species (compared with coral trout, Maori wrasse, and barramundi cod) does not justify the high level of research expenditure indicated by the 'R&D Requirements and Costing' study.

The benefit/cost model showed that a reef fish aquaculture industry in Queensland has the potential to be highly profitable, generating revenue in excess of AU$ 1 billion within 30 years under favourable conditions.

Using an 8 per cent discount rate over 40 years, the net present value of the research project could be of the order of AU$ 170 million, with a benefit:cost ratio of 16.6:1.

The financial evaluation (based on the economics of 100 t/yr production units, both land-based and offshore cages) indicated that farming reef fish species is potentially highly profitable.

Internal rates of return in excess of 100 per cent were indicated for aquaculture of barramundi cod and Maori wrasse, and 50 per cent for coral trout. Labour, feed and fingerling costs constitute the critical production costs. Harvesting, marketing and transport account for approximately 50 per cent of the overall costs, but might be reduced through changes in transport technology and increased economies of scale for larger production units.

Conclusion

With an increasing population base and growing affluence in Hong Kong and southern China, the market for live seafood, including live reef fish, seems set to increase for the foreseeable future. Prices are forecast to increase steadily for at least the next six years. It appears unlikely that this demand can be fully met by capture fisheries, particularly in view of the widespread environmental damage caused by unsustainable fishing techniques such as the use of cyanide and dynamite in many fisheries (Johannes & Riepen, 1995). Even where such practices are not used (e.g. the Queensland reef line fishery), there is relatively little potential for expansion of the capture industry. Increasing demand for live reef fish will have to be met by aquaculture product.

Our studies have shown that R&D costs for the development of a reef fish aquaculture industry are high, although comparable with the R&D costs for establishment of other finfish aquaculture industries. However, returns are also likely to be high, and the established industry should be highly profitable.

The main constraint to the development of a viable reef fish aquaculture industry is the technical difficulty associated with producing large numbers of fingerlings for grow-out. Although this aspect is specifically targeted in the proposed R&D programme, it is generally recognised that investment in R&D for reef fish aquaculture is high-risk, albeit with potentially high rewards.

The Queensland Government has recently encouraged the development of a reef fish aquaculture industry by supporting core research into the development of aquaculture techniques for high-value reef fish species at NFC. However, the level of funding supplied is well below that estimated in the Reef Fish Aquaculture Feasibility Study as being required to develop a viable industry within 10 years.

Consequently, additional funding will be required to facilitate industry development. While private investment funding is still being sought to facilitate commencement of the full R&D programme outlined above, there is also strong support for a coordinated regional approach to R&D for reef fish aquaculture.

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Additional information

A summary of the Reef Fish Aquaculture Feasibility Study findings (Industry Potential Snapshot brochure) is available from the authors of this paper, or from DPI Publications (see below).

Copies of individual reports from the Reef Fish Aquaculture Feasibility Study are available from:

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