Development of an ornamental fish breeding unit for the export market at Rose Belle Sugar Estate

Report of a study carried out by

Rose Belle Sugar Estate Board

in collaboration with the

University of Mauritius

under the

Private Sector Collaborative Research Scheme

of the

Mauritius Research Council

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EXECUTIVE SUMMARY

The study on the "Development of an ornamental fish breeding unit for the export market at Rose Belle Sugar Estate" emerged following policy decision to diversify our agricultural activities and the search for remunerative investment options. It was jointly carried with the University of Mauritius and financed under the Private Sector Collaborative Grant Scheme of the Mauritius Research Council.

The study has shown that import and export of ornamental fish is aminor activity and ornamental fish rearing is done on an amateur basis in Mauritius. Breeding and production are not carried out in Mauritius. Ornamental fish species are imported and then re-exported by a few dealers. Marine ornamental fishes are captured and then exported on a limited scale.

The potential of the export market has been shown.Three case studies of ornamental fish culture in Singapore, Thailand and Czekoslavakia have been included. However, as the market is very sensitive, specially with regard to sanitary norms, the breeding and production will require expert scientists and technicians. Quarantine needs of the Australian market, one of the most rigid to importation of live fishes have also been discussed.

The technical feasibility of the project has shown that it is a profitable enterprise. However, prior to full scale implementation a pilot project has been proposed as the technology needs to be developed and established sucessfully. This will help to fine tune the implementation of the project on an industrial scale.

The study has shown that this project is feasible and will be a good earner of foreign currency for Mauritius.

Development of an ornamental fish breeding unit for the export market at Rose Belle Sugar Estate

1 Preamble

The project entitled **Development of an ornamental fish breeding unit for the export market at Rose Belle Sugar Estate** was approved at the end of March 1999 under the Private Sector Collaborative Grant Scheme by the Mauritius Research Council.

This document discusses the various issues connected with the development of an ornamental fish breeding unit in Mauritius. It focuses more specifically on production for the export market.

2 Why Ornamental Fish?

Aquaculture of edible organisms has known a very slow growth in Mauritius. This state of affairs is due largely to inherent problems like unavailability of suitably large spaces, high cost of labour and competition with low-priced aquatic products imported from Madagascar and India.

However, aquaculture of ornamental fishes does not face the above constraints because the project can be carried out on a smaller surface area and the returns are more attractive because of the higher price (per unit biomass produced) that the product fetches in comparison to edible products.

3 Status of the ornamental fish culture industry in Mauritius

Aquarium fish keeping is a popular hobby in Mauritius. However, in spite of this popularity, there has been no sustained effort to develop an industry to supply the local market with aquarium fishes. Inquiries with interest groups indicate that the local market is too small to allow the development of such an industry. In the case of some species, the offsprings of just one specimen would be enough to meet a year's local demand.

If the ornamental fish industry is to be viable, it should be oriented towards the export market. Worldwide sales of ornamental fishes are estimated at US$900 million wholesale and three billion US$ retail with an annual growth rate of 10% (Infofish International, 1994 No.5). In the United States, keeping of ornamental fishes ranks as the second most favourite hobby after photography.

No formal report has been found on the status of ornamental fish culture in Mauritius. The only information available pertains to the data on aquarium fish import and export.

3.1 Species

The species presently being imported in Mauritius are as follows:

Name	Scientific Name
Red Platy	Xiphophorus maculatus
Neon tetra	Paracheirodon innesi
Salfin molly	Poecilia latipinna
Tiger barb	Capoeta tetrazona
Hi-fin leopard danio	Brachydanio frankei

Angels	Pterophyllum scalare
Clown loach	Botia macracantha
Red tail black shark	Labeo bicolor
Silver shark	Balantiocheilus melmopterus
Albino catfish	Corydoras albino
Silver catfish	Pangasius sutchi
Red plecko	Hypostomus plecostomus
Challenger catfish	Hi-fin pangassius
Oscar	Astronomous occellatus
Goldfish	Carrassius auratus
Koi	Cyprinus carpio
Fighter	Betta splendens
Silver dollar	Metynnis schereitmuelleri
Black tetra	Gymnocorymbus ternetzi
Lemon tetra	Hyphessorbrycon polchripinis
Black phantom tetra	Megalamphodus megaloptorus
Golden pencilfish	Nannestomus beckfordi
Ram	Microgeophagus ramirezi
Kribensis	Peluicachromis pulcher
Green tortoise	Pseudemys scripta elegan
Arowana Silver	Osteoglossum bicirrhosum
Discus	Symphysodon discus
Guppy (millions fish)	Poecilia reticulata
Black molly	Poecilia sphenops
Akelrodi brown discus	Symphsodon aequifascial

Angel fish	Pterophyllum dumerillo
Harlequin	Rasbora heteromorpha
Leopard danio	Brach danio frankei
One lined pencil fish	Namostomus unifasciatus
Scissor tail	Rasbora trilineata

Source: Ministry of Fisheries. Personal Communication

3.2 Present Mauritian importers of live ornamental fish

The Ministry of Fisheries has provided a list of importers of live ornamental fishes as follows:

Name	Address	Phone No.	Fax
Marks Aquarium clo Mark Leung	Ave.Zinnias, Morcellement Swan Baie du Tombeau	247 2453 247 1311	247 2456
Aqualife c/o M. Aubeeluck	College Lane, Curepipe	674 6702 252 0314	675 7727
Aquariophil (Y. Suffraz), Port Louis.	Ave. Calcutta, P. Verte	241 4695	240 4759
Aqua Shop, (P. Radha)	Ave. F. Mitterand, Centre de Flacq		413 4831
Aquabelle, (Y. Mooneyan)	Curepipe Road	674 8259 255 3292	
Water Paradise, (D. Lemann)	Forest Side.	674 4444	

3.3 Present Mauritian exporters of Live Fish

Name	Address	Phone No.	Fax
Pets Exports C/o Mark Leung	Ave. Zinnias Morcellement Swan Baie du Tombeau	247 2463 247 0311	247 2456
D. Pellicier	Morcellement Anna Flic en Flac	453 8109	

3.4 No. of live aquarium fish imported and origin

Year	Qty (units)	Origin
1996	211506	Singapore/Hong Kong
1997	205408	Singpore/Malaysial Hong Kong
1998	210041	Singapore/Malaysia/ U.K./Reunion

4 Status of the world import/export market

The hobby of keeping ornamental fish in either aquariums or ponds is popular on a global basis. In the UK it is estimated that 14% (3-3.5 million households) of all households own either an aquarium or pond. This makes them the third most popular pet group after cats and dogs. However the number of individual ornamental fish kept in the UK far exceeds that of either cats or dogs.

4.1 Countries exporting ornamental fish to the European Union during 1995

4.1.1 Marine tropical species

Aruba, Bahrain, Barbados, Belize, Canary Islands, Cape Verde, Costa Rica, Djibouti, Dominican Republic, Eritrea, Ethiopia, Fiji, Guadeloupe, Haiti, Kampuchea, India, Iran, Maldives, Mauritius, Netherlands Antilles, Oceania, Puerto Rica, S. Pierre Miquelon. ,

4.1.2 Marine, tropical and freshwater species

Australia, Bangladesh, Brazil, Cuba, Egypt, Japan, Kenya, Malaysia, Martinique, Nigeria, Philippines, Saudi Arabia South Africa, Sri Lanka, Thailand, United Arab Emirates, United States of America

4.1.3 Freshwater species

Albania, Argentina, Austria, Boliva, Brunei, Bulgaria, Burundi, Cameroon, Central African Republic, Chile, China People's Republic of, Colombia, Congo, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Djibouti, Ecuador, French

Guiana, Gabon Ghana, Guinea, Guinea-Bissau, Guyana, Hong Kong, Hungary, Indonesia, Israel.

4.2 Imports of ornamental marine fish

About 300,000 individual fish are imported into the UK annually, with a wet weight of just over 2 tonnes. An average value of £400,000 ($600,000) per tonne at import. In this period tropical Groupers and Wrasse were available from retail fishmongers for human consumption at approximately £10,000 per tonne wet weight.

4.2.1 Ornamental marine fish imports into the UK and EU in 1995

	Consigns	Boxes	Fish	Freight	Value(£)
Australia	23	393	10,987	2,770	22,825
Barbados	25	8,338	4,343	2,030	13,249
Costa Rica	9	190	1,924	2,070	11,413
Dom. Rep.	3	56	1,571	254	1,277
Fiji	25	520	21,907	8,771	44,319
Maldives	36	941	27,052	12,810	75,943
P. Rica	6	88	3,214	1,150	10,004
S. Arabia	9	141	2,075	2,202	17,350
TOTAL	136	2,567	73,350	32,057	196,380
As % of total imports of ornamental marine fish	-	-	-	32.4	27.5

4.2.2 Sources of Supply

The leading country in terms of supplies to the EU was, as expected, Singapore (25%).

Country	**%**
Singapore	25
Indonesia	9
SriLanka	9
NorthAmerica	8
Thailand	7
Brazil	6.5
China	6
HongKong	5
Israel	15
Malaysia	4
Nigeria3	
LatinAmerica(other than Brazil)	3
AsianPacific(other than Philippines)	3
Africa(other than Nigeria)	2
Philippines	2
Japan	1
Middle East	1
Caribbean	0.5

4.3 Tropical Fish Culture in Singapore

Keeping of ornamental fish is ever gaining in popularity, not only amongst home owners but also with business operators for their offices. The beauty of the fishes and their graceful swimming movements impart a therapeutic effect to the viewer, and constitutes "living art" to grace entrances and concourses of modern buildings. Outdoor ponds form an integral part of garden landscapes. Increasingly hobbyists and pond owners are becoming more discerning for quality fish, and suppliers and producers would need to place even greater emphasis on quality control and adopt good management practice. A farm in Singapore has achieved ISO standards for export and it is hoped that more farms will attain this standard in the near future.

Singapore is regarded in the ornamental fish business as the ornamental fish capital of the world, having been in the business of trading and production for more than half a decade. From Singapore, fishes are sent to more than 60 countries worldwide, and its export, in terms of value, constitutes over 30% of global exports. In 1997, Singapore exported S$78 million worth of ornamental fish, a decline of 6.0% over the previous year's export value due to the Asian economic turmoil. The island republic is also a major importer of ornamental fish, being ranked 7th in position in terms of value of the trade.

4.3.1 Buyers & Products

The top 10 countries which buy ornamental fish from Singapore are Japan, USA, UK, Germany, France, Italy, Spain, Netherlands, Belgium & Switzerland. The main groups of fish sold from Singapore are the guppy, tetra, platy, gourami, molly, goldfish, catfish, swordtail, barb, angelfish, rasbora, other cichlids, danio, loach, fighting fish, bala shark, discus and koi. New species and varieties are being produced annually, with a trend amongst breeders to specialise in breeding

exquisite species and varieties, and farmers producing the more popular ones in bulk.

4.3.2 Distribution

The distribution system for the industry is relatively well developed. The breeders and farmers, as producers sell their fish to wholesalers, who could also be importers. Both wholesalers and importers buy fish from farms in the region, with the latter in smaller quantities, distributing locally to breeders, and/or sale to farmers. Importers and exporters hold a common licence, Import/Export/Transhipment of Ornamental Fish Licence, and so importers and exporters can do both activities. There is a trend in recent years towards vertical integration of the roles, as exporters turn to farming to guarantee a more stable supply for their business and in the process ensure better management control over output and quality of fish produced.

4.3.3 Farming

The farms are located in modern farming estates called Agrotechnology Parks, managed by the Primary Production Department of Ministry of National Development. There are 126 ornamental fish farms in Singapore covering 237 hectares. In 1997, these farms produced S$32.2 million worth of fish (export value), with the top 10 most popularly farmed fishes being guppy, tetra, goldfish and koi, platy, loach, swordtail, Dragon Fish, gourami, angelfish and molly. Some farms have developed water recirculating systems to reuse farm wastewater to safeguard against the vagaries of the environmental elements in an open flow-through system. More robust varieties of guppy, having special beautiful features, have also been produced, and these are enthusiastically received by the market. New species and varieties are featured in PPD's web page regularly.

4.3.4 Quality Assurance

As part of Quality Assurance, the Primary Production Department administers and Accreditation Scheme for exporters of ornamental fish. The scheme was started in 1992. Membership is voluntary and costs S$940 annually. The scheme ensures that members have dedicated conditioning and packing areas within their export premises which meet high hygiene standards. Members need to maintain a recording system on their source of fish supply, stocking in the tanks, and exports, as well as abide by a specially developed Code of Practice for export. PPD officers visit and check the export premises routinely, and sample the water for bacteria and fish for parasites and Spring Viraemia of Carp Virus (SVCV). Membership entitles exporters to export to UK, Spain and Australia.

To maintain the quality of Dragon, fish exported from Singapore, PPD has made it mandatory for producers of Dragon Fish to register in its scheme entitled: Membership Scheme on the Tagging and Certification of Identity of F2 and beyond Dragon Fish or Arowana, Scleropages formosus, produced by farms in Singapore through Captive Breeding. Under the scheme, started in 19 Aug 1994, members would need to subject all its Dragon Fish in the farm to electronic tagging and maintain records of stocks and sales. To export, members would need to register their farms under the Convention on International Trade Endangered Species (CITES) of Wild Fauna and Flora, whose secretariat is based in Geneva, Switzerland. Two of the members' farms are currently registered with CITES.

PPD has also implemented a scheme in 18 may 1998 entitled: Ornamental Fish Premises Monitoring Scheme for Salmonella-Free and Fibrio Cholera-Free status. Exporters to Italy would need to purchase their fish from members of this scheme to ensure that their consignments are derived from premises free of the said pathogens. Membership is free but members need to pay for the tests.

Another scheme implemented recently in 17 June 1998 is on the screening of SVCV in fish imported from China. Due to the recent placement of China in the geographical range of SVCV, koi and goldfish from China would need to be quarantined and screened for SVCV before release to the market (local or

overseas). No membership is required but the user would need to pay for the screening.

Singapore has become one of the world's largest producers and exporters of tropical aquarium fishes. It is not too unexpected then, to find a most extensive web site on tropical fish culture, hosted by the Department of Biological Sciences of the National University of Singapore.

4.3.5 Genera produced in Singapore

Acanthodoras	Dermogenys	Nyriophyllum
Acanthopthalmus	Discus	Oftalmotilapia
Acidon	Distichodus	Ophiopoghon
Acipenser	Echinodorus	Oreochromis
Acorus	Echinodorus	Pachypanchax
Aequidens	Egeria	Papiliochromis
Agamixis	Ellasoma	Paracheirodon
Aglauena	Epiplatys	Paracyprichromis
Alfaro	Eretmodus	Pelmatochromis
Alternathera	Etroplus	Pelvicachromis
Ambasis	Eustralis	Pelvicachromis
Amblydoras	Geophagus	Petrochromis
Ambystoma	Girardinus	Petrotilapia
Ameca	Glossolepis	Phallichthys
Ammania	Gymnocoronis	Phenacogrammus

Ampularia	Gymnocorymbus	Pimelodella
Anabas	Gymnogeophagus	Placidochromis
Ancistrus	Haplochromis	Plataplochillus
Anostomus	Hasemania	Platydoras
Anubias	Helostoma	Pleurodela
Anubias	Hemichromis	Poecilia
Apanageton	Hemigrammus	Polycentrus
Aphyocharax	Hemigrampetersius	Popondetta
Aphyosemion	Hemigraphis	Potamogeton
Apistogramma	Heros	Potamon
Aplocheilus	Herotilapia	Priapella
Aponogeton	Heterandria	Prionobrama
Aponogeton	Heteranthera	Pristella
Aristochromis	Heteropneustes	Procambarus
Astatotilapia	Hoplosternum	Procathopus
Astronotus	Houtuynia	Pseudocrenilabrus
Astyanax	Hydrocotyle	Pseudoepiplatys
Atyia	Hydrotriche	Pseudosphromen
Aulonocara	Hygrophila	Pseudotropheus
Austrofundulus	Hymenochirus	Pterolebias
Bacopa	Hyphessobrycon	Pterophyllum
Bacopa	Hypselacara	Pterophyllum
Badis	Illyodon	Rachovia
Balantiocheilus	Inpaichthys	Rasbora
Balbitis	Iodotropheus	Rhodeus

Barbus	Iriatherina	Rineloricaria
Bedotia	Jordanella	Rivulus
Belonesox	Julidochromis	Roloffia
Belontia	Julidochromis	Rotala
Betta	Justicia	Rotala
Blyxa	Labeo	Sagittaria
Brachydanio	Labeotropheus	Samolus
Braxygobius	Labidochromis	Sarotherodon
Brycinus	Laetacara	Saururus
Cabomba	Lamprologus	Schilbe
Calochromis	Leocasis	Scyphia
Camomba	Lepomis	Selaginella
Carassius	Leporinus	Serrasalmus
Ceratophyllum	Leuciscus	Spatiphyllum
Chalinochromis	Lilaeopsis	Sturisoma
Chamidogobius	Limia	Symphysodon
Chana	Limnophila	Symphysodon
Cheirodon	Loricaria	Syngnathus
Chilatherina	Ludwigia	Synodontis
Chilodus	Lysimachia	Taeniacara
Chlorophytum	Macropodus	Tanichthys
Chromidotilapia	Mastacembelus	Tateurdina
Cichlasoma	Megalamphodus	Telmatherina
Colisa	Melanochromis	Telmatochromis
Copella	Melanotaenia	Teranotos

Corydoras	Mesogonistius	Tetraodon
Corynopoma	Mesonauta	Thayeria
Crenicara	Metynnis	Thorichtis
Crenicichla	Microsorium	Thysia
Cryptocoryne	Mix_mosquito	Tilapia
Cryptocoryne	Moenkhausia	Tinca
Ctenobrycon	Myrfophyllum	Trematocranus
Ctenolucius	Mystus	Trichocornis
Ctenopoma	Nannacara	Trichogaster
Cyanofarinds	Nannobrycon	Trichomanes
Cynolebias	Nannocharax	Trichopsis
Cynopoecilus	Nannostomus	Tropheus
Cynotilapia	Nanochromis	Tropical_quintet
Cyphotilapia	Neetroplus	Uaru
Cyprichromis	Nematobrycon	Vallisneria
Cyprinus	Neolebias	Xenopus
Cyrtocara	Nomorhamphus	Xenotoca
Danio	Nothobranchius	Xiphophorus

4.4 Ornamental fish Culture in Thailand

The latest trend among Americans and Europeans living in Thailand, and even Thais living in condominiums, to keep brightly coloured tropical fish as pets rather than dogs and other large animals, is transforming a backyard industry into a multi-million dollars operation. According to Thanavooth Wangtal, head of a group of villages in Ratchaburi - an area better known as the country's fruit

growing basket - it is fast becoming a breeding ground for guppies, goldfish and other ornamental fishes. He said although a handful of farmers have bred fish in the area for more than 30 years, during the last few years the industry has boomed and more than 200 farmers have jumped on the bandwagon as returns are often higher than their fruit crops.

Ratchaburi, 100 km west of Bangkok, now raises 60% of the nation's ornamental fish with a retail export market valued at 75 billion baht. But while farmers have invested heavily in the burgeoning new industry, they have been forced to learn the hard way as they have no marketing experience and lack skills in international trade. The lack of skills means farmers must rely on international brokers, who take a large portion of the sale price. Farmers also face difficulties finding strains to meet international demand, high tariffs imposed on importing breeding stock and entering new markets.

Chakaard Sripo, owner of Chakaard Guppy Fish Farm and a major exporter, wants the government to play a more active role in helping the industry by finding better strains. His farm exports more than one million fishes annually and supplies the local market with 500,000. He said local guppy raisers found it difficult to gain access to good progenies, alleging that Singapore, the distribution hub for the variety, was attempting to hinder the development of the Thai industry, fearing that the kingdom could become a major competitor. A large number of Japanese investors have already established guppy farms in the province. However, they keep cultivation techniques confidential and there is no benefit to Thai farmers. Luckily, the Japanese operators export their fish to Japan and do not compete in Thailand's markets of America and Europe.

Thailand's major competitor in America and Europe is Singapore, and local farmers say they are currently at a disadvantage. Somporn Lohsawatkul, Ratchaburi Provincial Fisheries Officer, said Thailand could stand on par with Singapore within the next three years if local farmers can develop hatchery techniques, fish handling and transportation. Overcoming technical difficulties is not beyond Thailand's reach if farmers work together to exert pressure for tax refunds when importing fish to produce fingerlings for the export market, said

Wanpen Minkanjana, director of the Fancy Fish and Plant Varieties Research and Development Institute. She also said the collective power of farmers could pressure the fishery department to arrange training courses and provide other support. The Fisheries Department will establish groups based on fish varieties in the near future to encourage the exchange of techniques and market information. Furthermore, it has set aside 98 million baht to promote the ornamental fish industry through the establishment of the Ornamental Fish Export Centre. The centre, to be completed next year, will facilitate trading of the fish throughout the year.

4.5 The Ornamental Fish Industry in The Czech Republic

In the recent years, the Czech Republic developed into Europe's emporium with regard to the breeding of aquarium fish. However, as a result of the changes that occurred in 1989, production and export were greatly influenced. For example, rising energy, water and gasoline prices, which are slowly catching up with those in the EU, have forced breeders to modify the methods they employ, as well as the assortment they can offer, along with their sales approach.

The assortment

There are about 500 different types of aquarium fish available within the Czech market, depending on season of the year. Even as recently as the early 90's, this assortment included several species which were bred primarily for fun. These included, for example, Aplocheilus (Epiplatys) annulatus, Dermogenys pusillus, Elassoma evergladei, Tetraodon fluviatilis and Stevardia (Corynopoma) riisei . However, most of these are now disappearing from the selection of fish that are offered.

Export is the main driver of production and this has increased by 15% between 1995 and 1997. The main and most significant advantages of Czech-bred fish are

their high adaptability and disease resistance. Those who import fish from our country are well aware of these advantages, which also result in reduced quarantine and post-shipment treatment expenses.

4.5.1 Exports

The accompanying table lists the export value of ornamental fish for 1995 and 1997, to allow for easy comparison between the two years.

Italy is a great market for the Czech Republic. However, reliability is a problem and, were this not to be the case, the volume of exports to Italy could be as high as for France. Spain, which featured in the 'Top Ten' in 1995, has dropped out and has been replaced by Great Britain, where Czech fish are becoming progressively more popular. This trend is expected to continue, in direct contrast to trade with Spain, where exports have fallen by 60% - the highest drop shown by any country. Four countries which do not feature in the 'Top Ten', but which should be mentioned are: the USA (+800% - US$105,000),Denmark (US$62,400), Norway (US$48,530) and Japan (US$14,250), compared to no trade at all in 1995).

Bearing in mind that the age of the Internet is here, Czech fish will probably soon be exported to some of the lesser-known markets, such as Saudi Arabia and South Africa.

4.5.2 Export Value of Ornamental Fish

COUNTRY	Export in 1997 in US $	Export in 1995 in US $
Germany	4.6m	4.0m
France	1.9m	1.6m
Austria	470,000	392,000
Italy	429,000	297,000
Netherlands	364,000	412,000
Belgium	359,000	326,000
Sweden	201,000	106,000
Great	Britain	189,000
Slovakia	185,000	116,000
Switzerland	166,000	140,000
Spain	-	220,000

(Source: General Headquarters of Customs, Czech Republic, Prague)

4.5.3 Imports

Since 1995 ,imports have risen by 12%. However, those from Germany have actually dropped. This is probably as a consequence of some firms having their consignments shipped directly to Prague, where processing of the paperwork is speedy and can take as little as one hour. Imports from Slovakia have also decreased. In this case, the reason is that some fish previously obtained from Slovakia can now be replaced through local production. Brazil experienced a drop which I attribute to the poor acclimatization capabilities of imported Cardinal Tetras (Paracheirodon axelrodi). This has resulted in imports of this species being totally replaced by locally produced fish.

4.5.4 Import Value of Ornamental Fish

COUNTRY	Position in 1997	Position in 1995	US$ approx.) in 1997	US$ approx.) in 1995
Germany	1	1	75,270	133,300
Singapore	2	3	48.700	18,700
Thailand	3	6	20,670	3,500
Slovakia	4	2	9,830	33,300
Colombia	5	5	6,660	5,100
Netherlands	6	8	5,500	870
Brazil	7	4	3,700	18,600
Hong Kong	8	-	2,190	-
Malaysia	9	12	1,500	-
Indonesia	10	9	1,460	660
Nigeria	-	7	-	3,300
Great Britain	-	10	-	146

Source: (Source: General Headquarters of Customs, Czech Republic, Prague)

5 Indicative World Export Prices (F.O.B. Beijing in US$)

5.1 Packing & Price List of Goldfish

		Dragon eye	Oranda	Fringe tail (Ryukin)	Sarasa Fantails	Red Cap	Lion Head (redr/ w)	Lion Head (blank calico)	Ranchu (redr/w)
Pcs/ box	Size	Price	Price	Price	Price	Price	Price	Price	Price
600	4-5	0.12	0.12	0.12	0.12	0.16	0.16	0.17	0.14
500	5-6	0.15	0.15	0.15	0.15	0.19	0.20	0.21	0.16
400	6-7	0.18	0.18	0.22	0.20	0.25	0.27	0.29	0.24
350	7-8	0.24	0.26	0.35	0.24	0.33	0.33	0.42	0.40
250	8-9	0.30	0.37	0.53	0.30	0.44	0.57	0.63	0.66
150	9-10	0.40	0.59	0.68	0.40	0.60	0.86	1.04	1.10
100	10-11	0.53	0.67	0.74	0.56	0.74	1.22	1.29	1.77
80	11-12	0.59	0.74	0.80	0.67	0.93	1.27	1.34	2.12
60	12-13	0.76	0.84	0.84	0.84	1.35	1.52	1.60	3.05
50	13-14	0.87	1.08	1.08	1.08	1.76	1.76	1.85	

40	14-15	1.01	1.35	1.35	1.35	2.19			
35	15-16	1.11	1.59	1.59	1.59	2.27			
30	16-17	1.34	2.02	2.02	2.02	2.70			
25	17-18	1.70	2.61	2.61	3.61	3.52			
20	18-19	2.81	3.18	3.18	3.18	3.72			

		High Crowned (R&B)	Butterfly (redblack)	Butterfly (calico)	Bubble Eye (R&B eye)	Bubble Eye (r/wcalico)	Pearl (r/w calico)	Pearl (crowned)	Celestail
Pcs/ box	Size	Price	Price	Price	Price	Price	Price	Price	Price
400	5-6	0.32	0.16	0.23	0.23	0.23	0.30	0.36	0.27
300	6-7	0.43	0.25	0.34	0.34	0.34	0.43	0.45	0.36
250	7-8	0.53	0.37	0.44	0.44	0.44	0.53	0.56	0.44
200	8-9	0.64	0.55	0.64	0.55	0.55	0.64	0.68	0.55
100	9-10	0.80	0.93	0.93	0.74	0.74	0.84	0.88	0.74
80	10-11	0.85	1.27	1.16	0.90	0.90	0.98	1.21	0.98
70	11-12	1.34	1.47	1.74	2.65	1.34	1.27	1.45	1.37

60	12-13	2.79	1.79	2.15	3.42	1.79	1.60	1.69	1.60
50	13-14	2.40	2.58	3.12	4.76	2.40	-	-	-
40	14-15	-	-	-	-	-	-	-	-
30	15-16	-	-	-	-	-	-	-	-
20	17-18	-	-	-	-	-	-	-	-

		Commonfish(red)	Commonfish(R/B)	Sarasa(R/W)
Pcs/box	Size	Price	Price	Price
500	4-6			
400	6-8			
300	8-10			
200	10-12			
120	12-15			
70	15-18	50.00USD/BOX	55.00USD/BOX	65.00USD/BOX
35	18-20			
20	20-22			
18	22-25			
14	25-27			
8	27-30			

		KoiCarp	Shubunkin
Pcs/box	Size	Price	Price
300	6-8		
200	8-10		
150	10-12		
90	12-15		
60	15-18		
30	18-20	80.00USD/BOX	80.00USD/BOX
20	20-25		
16	25-28		
12	28-30		
8	30-35		
6	35-40		

5.2 Packing & price list of tropical fish and cichlids fish

NO.	LatinName	Size(CM)	F.O.B (Beijing)$	pcs/box
1	Tribellis	4~5	0.25	500
2	Trichogasterleeri	6~7	0.25	400
3	Trichogaster trichopterus(cosby)	4~5	0.13	500
4	Trichopterus(white)	4~5	0.13	500
5	Helostomatemmincki	4~5	0.14	500
6	Colisalalia(female)	3~4	0.13	600
		5~6	0.31	400

7	Colisalalia(red)	4~6	0.94	450
8	Etroplsmaculatus(var.)	7~8	0.38	300
9	Hemichromisbimaculatus	5~6	0.19	400
10	Astronotusocellatus(tiger)	12~14	3.77	60
11	Cichlasomacitrinellum	5~7	0.22	400
12	Balantiocheilos melanopterus	5~6	0.63	400
13	Labeobicolor	4~6	0.47	500
14	Brachydaniorerio(var.)	4~6	0.06	500
15	Hemigrammusocellifer	3~5	0.13	600
16	Hyphessobryconflammeus	3~5	0.16	600
17	Hyphessobrycongriemi	3~4	0.19	2000
18	Hyphessobryconinnesi	2~3	0.09	2500
19	Hyphessobrycon heterorhabdus	3~4	0.13	2000
20	Thayeriasanctaemariae	3~4	0.38	2000
21	Poecilia reticulatus£¨calico)	4~5	0.19	500
22	Poecilia reticulatus(red)	4~5	0.22	500
23	Poecilia latipinna	4~6	0.25	500
24	Xiphophoru shetleri	5~6	0.31	400
25	Xiphophoru shelleri	3~4	0.09	500
26	Mickey Mouse (platy)	3~4	0.22	500
27	Scatophagusargus	4~5	1.01	500
28	Rasbora heteromopha	3~5	0.47	500
29	Puntius tetrazona	3~4	0.13	500
		4~6	0.38	400
30	Cichlasoma meeki	5~6	0.25	400

Cichlids

1	Protomelastaeniolatus	4~5	2.04	500
		5~6	2.52	400
		6~7	3.15	200
		7~8	3.77	160
		9~10	5.66	120
2	Tropheusmoorii	2~3	15.41	600
2	Tropheusmoorii	4~5	21.07	500
		6~7	43.40	200
3	Nimbochromis fuscotaeniatus	4~5	2.36	400
		6~7	3.77	300
		8~9	6.92	140
4	Melanochromisauratus	2~3	0.47	1200
		3~5	1.10	1000
		5~6	1.42	600
5	Cyphotilapiafrontosa	4~5	10.69	250
		7~8	25.79	160
		8~9	28.31	120
6	Dimidiochromis compressiceps	4~5	1.57	500
		5~6	2.04	400
		7~8	3.30	200
		9~10	5.19	140
7	Aristochromischrisstyi	5~6	2.04	400
		7~8	3.77	200

		9~10	5.66	120
8	Pseudotropheuslanisticola	4~5	2.04	500
		6~7	4.40	300
9	Sciaenochromisahli	5~6	1.42	400
		6~7	2.04	250
		7~8	2.36	160
		8~9	3.30	140
		9~10	3.93	100
		10~11	4.72	80
10	Labidochromiscaeruleus	3~4	0.94	600
		4~5	1.26	500
		5~6	1.73	320
		6~7	2.20	280
		7~8	2.99	240
		8~9	3.77	160
		9~10	5.19	100
11	LabidochromisSP.	3~4	0.94	600
		4~5	1.26	500
		5~6	1.73	400
12	LabidochromisSP	6~7	2.20	300
		7~8	2.99	180
		8~9	3.77	140
		9~10	5.19	100
13	Pseudotropheussocolofi	3~4	1.10	600
		4~5	1.26	500

		5~6	1.73	400
13	Pseudotropheussocolofi	6~7	2.52	300
		7~8	3.15	180
		8~9	3.93	140
		9~10	5.19	100
14	Pseudotropheuslombardoi	3~4	0.63	1000
		4~5	1.10	700
		5~6	1.26	600
		6~7	2.52	300
		7~8	2.83	200
		8~9	3.30	160
		9~10	4.56	100
15	Pseudotropheussocolofi	3~4	1.26	500
		5~6	2.04	400
		7~8	3.62	200
		8~9	5.50	140
16	Lamprologustetracanthus	5~6	2.99	250
		6~7	3.62	180
		7~8	4.56	140
		9~10	5.82	100

6 Other considerations for the industry

6.1 Diseases

6.1.1 Goldfish haematopoietic necrosis virus (GFHNV)

A herpesvirus isolated from moribund fish in Japan has been demonstrated to be the cause of epizootics of herpesviral haematopoietic necrosis of goldfish (HVHN) in cultured goldfish (*Carassius auratus*) with mortality rates approaching 100%. Sporadic cases of herpes-like virus have been reported from goldfish in Australia. The relationship of these to GFHNV is uncertain.

6.1.2 Infectious pancreatic necrosis virus (IPNV)

In this IRA, 'infectious pancreatic necrosis' (IPN) describes the acute disease of juvenile salmonids caused by infection with an aquatic birnavirus. The various strains of virus that cause IPN–referred to as infectious pancreatic necrosis virus (IPNV)–differ in virulence and serological characteristics. The virus is widespread in Europe (including the UK), North America, Chile and Asia, but to date has not been isolated from Australia.

6.1.3 Pike fry rhabdovirus (PFR)

Also known as hydrocephalus or red disease of pike, PFR is an infrequently reported, acute to subacute haemorrhagic syndrome associated with generalised oedema, haematopoietic necrosis and high mortality in pike fry (*Esox lucius*). As a naturally occurring disease, it occurs throughout eastern and western Europe. PFR is readily transmitted by contact and by exposure to waterborne infectivity, and has not been reported from Australia.

6.1.4 Spring viraemia of carp virus (SVCV)

SVC (*Rhabdovirus carpio*) is listed by the OIE as a notifiable disease. The agent is a rhabdovirus causing mortality throughout Europe where carp are cultured. Clinical signs are mostly non-specific and include lethargy, darkening of the skin

and loss of balance, oedema and necrosis in organs such as liver, pancreas, kidney, heart, brain, intestine and swimbladder.

SVC occurs mainly in young fish of all major cyprinid species. The disease can be transmitted by blood-sucking parasites such as fish lice (*Argulus foliaceus*) and leeches (*Piscicola geometra*).

6.1.5 Viral encephalopathy and retinopathy virus (VERV)

A syndrome of epidemic mortalities in larvae and juveniles of various fish species, viral encephalopathy and retinopathy (VER), also termed viral nervous necrosis (VNN), is caused by a nodavirus infection characterised by vacuolating retinopathy and encephalopathy. The virus has been detected in Australia in correlation with mass mortality in hatchery-raised larval and juvenile barramundi. Only one of the viruses of this group is known from Australia, while viruses of a number of species are reported from northern Asia, for example, and Europe.

6.1.6 Herpesvirus cyprini

Also termed carp pox or epithelioma papillosum, *Herpesvirus cyprini* in koi carp (*Cyprinus carpio*) causes lesions on the body surface and fins, often coalescing to cover large areas of the epidermis. Although fish growth may be retarded, mortalities have not been reported. The infection remains mostly latent with disease symptoms appearing when fish are stressed. This is a chronic viral infection affecting mainly fish older than one year in a wide range of cyprinids and other aquarium fish species.

6.1.7 Vibrio cholerae

Vibrio cholerae is a pathogen of ornamental finfish and should be considered in the IRA. *V. cholerae* can be recovered from the aquatic environment, both freshwater and seawater. Isolates tend to be non-O1 serotypes and not the classical toxigenic human *V. cholerae* strains. Non O1 *V. cholerae* has been isolated in Australia from diseased goldfish recently imported from Singapore

6.1.8 Yersinia ruckeri (Hagerman strain)

Yersinia ruckeri, a member of the enterobacteriaceae is the cause of enteric red mouth (ERM) of salmonids and is a recognised fish pathogen. At least four serotypes have been identified. Serotype O1 is subdivided into O1a and O1b. O1a (formerly Type 1) is the 'Hagerman strain', the most common and virulent of the serotypes The other serotypes are considered relatively avirulent.

6.1.9 Mycobacterium marinum, M. fortuitum and M. chelonae

Mycobacteriosis affects a wide range of freshwater and marine aquarium fish Three species, *Mycobacterium marinum, M. fortuitum,* and *M. chelonae* have been associated with fish disease. *M. piscium* is not considered to be a taxonomically valid species.

6.1.10 Nocardia asteroides and Nocardia 'kampachi'/seriolae

With the exception of *N. kampachi* recorded from cultured yellowtail, nocardiosis of fish is a chronic disease, occurring sporadically and affects only a small percentage of a fish population, causing light mortalities. *N. asteroides* has been isolated from neon tetras, giant gouramis, salmonids and yellowtail. *N. 'kampachi'/seriolae* is an important pathogen of yellowtail in Japan, but does not appear to have been recorded from any other species of fish. *N. seriolae* is a valid species and includes isolates formerly described as *N. 'kampachi'*.

6.1.11 Photobacterium damselae damselae

Photobacterium damselae damselae (formerly *Vibrio damsela*) was originally reported causing disease in damselfish (*Chromis punctipinnis*).

6.1.12 Streptococcus iniae

Streptococci are an emerging problem in both freshwater and marine aquaculture. *Streptococcus iniae* has been associated with septicaemia leading to significant mortality in aquaculture. Streptococcosis of fish is associated with a wide range of species including cichlids and salmonids.

6.1.13 Saprolegniaceae

Saporlegnia infections occur commonly in ornamental fish. Saprolegniaceae are ubiquitous in freshwater ecosystems and appears to infect most species of fish as secondary invaders. Integumental damage and low water temperature initiate hyphal growth, leading to ulceration of the epidermis which results in osmoregulatory failure.

6.1.14 Brooklynella hostilis

Brooklynella is the marine counterpart of the genus *Chilodonella*. *B. hostilis* is a highly lethal pathogen associated with gill epithelial destruction, haemorrhage, respiratory dysfunction, disorientation and death, and has been reported to cause disease in both wild and captive marine fishes, such as angelfish and dhufish, from a wide range of geographic locations.

6.1.15 Pleistophora (Plistophora) hyphressobryconis

Pleistophora spp. are invasive microsporan protozoa that have been associated with tissue destruction and epizootic mortalities. Pleistophorans are not host specific and may cause severe disease in aquaculture. Infection may result in spinal curvature, equilibrium disfunction, weight loss, muscular paralysis, fin degeneration and death. *P. hyphressobryconis*, *P. anguillarum*, *P. gadi*, *P. macrozoarcides*, *P. cepediane* and *P. ovariae* have been associated with severe disease and/or death. Of these, only *P. hyphressobryconis* is associated with ornamental finfish species, affecting mainly tetras, but also a variety of other freshwater ornamental fishes angelfish, barbs, rasboras, and goldfish.

6.1.16 Cryptocaryon irritans

Cryptocaryon irritans is the marine counterpart to *Ichthyophthirius multifiliis* (whitespot). Marine whitespot is the cause of serious epizootics in aquarium and farmed fish. The disease is characterised by dark body colouration, eyeball opacity, excessive mucus production, respiratory distress and lethargy, leading to death.

6.1.17 Goussia carpelli

Goussia spp. have been associated with growth retardation, emaciation and enteritis and may cause epizootic mortalities, especially under farmed conditions. In carp grow-out and hatchery operations, *Goussia carpelli*-coccidiosis leads to high financial losses with prevalence reaching up to 100% in young fish. *G. carpelli* has been reported from Europe and North America and has also been reported from goldfish in Asutralia. Two species of *Goussia* have been recorded from aquarium fish, namely, *Goussia cichlidarum* and *G. trichogasteri,* from cichlids and gouramis, respectively

6.1.18 Kudoa

The genus *Kudoa* contains species that have pathogenic and economic importance. *Kudoa thyrsites* causes post-mortem myoliquefaction. While infection with *K. thyrsites* is usually unrelated to mortality, it affects market value of infected fish. While many of the recorded 37 *Kudoa* species cause post-mortem myoliquefaction, there is a high degree of host specificity and a balanced relationship between parasite and host. Exceptions are *Kudoa paniformis* which appear to cause heavy and continuing infections and *K. clupeidae* which may induce heavy mortalities in young clupeoids. *Kudoa thyrsites* infects many species of marine fish.

6.1.19 Capillaria

Capillaria nematodes are frequently found in freshwater aquarium fish. Their clinical significance is difficult to determine and they are usually only found post-mortem. Anecdotal evidence suggest they may affect reproductive potential and growth rates. *Capillaria* have been reported to cause ulceration and emaciation. *Capillaria philippinensis* causes capillarasis in its freshwater fish intermediate hosts. The primary hosts include humans, monkeys and birds. Several species of freshwater ornamental fishes have been infected experimentally and include guppies, carp and rasboras.

7 Potential for development

7.1 Potential species

Apart from the species that are currently being imported, potential species for culture are:

Black tetra	(Gymnocorymbus ternetzi)
Blind cave characin	(Anoptichthys jordani
Cardinal tetra	(Cheirodon axelrodi)
Lemon tetra	(Hyphessobrycon pulchripinnis)
Neon tetra	(Hyphessobrycon innesi)
Penguin fish	(Thayeria sanctae-mariae)
Piranha	(Serrasalmo nattereri)
Red-eyed Moenkhausia	(Moenkhausia sanctaefilomenae)
Black 'shark'	(Morulius chrysophekadion)
Five-banded barb	(Barbus pentazona pentazona)
Harlequin fish	(Rasbora heteromorpha)
Red-tailed 'shark'	(Labeo bicolor)
Rosy barb	(Barbus conchonius)
Tiger barb	(Barbus lateristriga)
Tiger barb	(Barbus tetrazona tetrazona)
Zebra fish	(Brachydanio rerio)
Black-spotted catfish	(Corydoras melanistius)
Bronze catfish	(Corydoras aeneus)
Glass catfish	(Kryptopterus bicirrhus)
Leopard Corydoras	(Corydoras leopardus)
Sucker catfish	(Hypostomus plecostomus)
American flagfish	(Jordanella floridae)
Argentine pearl fish	(Cynolebias bellottii)
Striped panchax	(Aplocheilus lineatus)
Guenther's Nothobranch	(Nothobranchius guentheri)
Guppy	(Poecilia reticulta)
Molly	(Poecilia sphenops)
Platy	(Xiphophorus maculatus)
Sailfin molly	(Poecilia latipinna)
Swordtail	(Xiphophorus helleri)
Chocolate gourami	(Sphaerichthys osphromenoides)
Comb-tail paradise fish	(Belontia signata)
Croaking gourami	(Trichopsis vittatus)
Dwarf Gourami	(Colisa lalia)
Giant gourami	(Osphronemus goramy)
Honey gourami	(Colisa chuna)
Indian gourami	(Colisa fasciata)
Kissing gourami	(Helostoma temmincki)
Paradise fish	(Macropodus opercularis)

Pearl gourami	(Trichogaster leeri)
Siamese fighting fish	(Betta splendens)
Snake-skinned gourami	(Trichogaster pectoralis)
Thick-lipped gourami	(Colisa labiosa)
Thin-lipped gourami	(Trichogaster microlipis)
Three-spots gourami	(Trichogaster trichopterus trichopterus)
Angelfish	(Pterophyllum scalare)
Discus	(Symphosodon discus)
Kribensis cichlid	Pelmatochromis kribensis)
Oscar	(Astronotus ocellatus)
Ramirez's dwarf cichlid	(Apistogramma ramirezi)
Algae eater	(Gyrinocheilus aymonieri)

The technical aspects of the culture of the above species are discussed in topic

7.2 Export charges for air shipment of live fish from Mauritius (Dec.99)

7.2.1 Local charges

- Pick up — on request
- Broker's fee — Rs 570.00 +10%,Value Added Tax

(vat) per bill of entry

- Air Way Bill (awb) fee — Rs.200.00 per shipment
- Handling fee — Rs.300.00 per shipment

7.2.2 Freight

Place of final destination	Minimum Charge	Per Kilo Charge
Antananarivo	1650.00	56.50
Durban	2145.00	160.05
Frankfurt	2145.00	330.90
Johannesburg	2145.00	142.30
London	2145.00	330.90
Milan	2145.00	330.90

Paris	2145.00	330.90
Reunion	1650.00	39.85
Seychelles	1650.00	76.30

Notes:

(1) All rates are in Mauritian rupees. Freight charge is calculated on a

minimum charge (lumpsum) and thereafter on a per kilo basis at the applicable flat rate, e.g. a consignment to London at a chargeable weight of 6 kilos will be charged at a minimum charge of Rs2145.00 (lumpsum) whereas a consignment of 7 kilos will be charged at (7 x 330.90) = Rs.2316.30.

(2) Rates are subject to change without prior notice at discretion of carrier

(3) Acceptance of cargo is subject to prevailing carrier's rules & regulations at time of shipment

(4) It is the shipper's responsibility to ensure that shipments comply with all imports health/sanitary regulations in force in the country 0f destination at time of shipment (health certificate, certificate of origin, etc.)

7.3 Procedures to be followed for export of live fish from Mauritius

• EO1 form to be filled for registration before export (available from export organisation e.g. Rogers Air Cargo)

• Must obtain permit from Ministry of Fisheries and Quarantine Certificate from Veterinary Services of Ministry of Agriculture

• Include invoice indicating live weight of aquarium fish, number of packages and total weight.

• Export organisation will prepare export permit

• EUR1 certificate for all EEC countries to be secured

• COMESA certificate for East African Countries required

• COI certificate for Madagascar, Comores and Seychelles required

• MCCI certificate for all other countries required for all other countries

7.4 Carriers to Europe

The two airlines which carry the largest numbers of consignments into Europe are KLM and Lufthansa (each accounting for 15% of all imports.

Airline	%
KLM	15
Lufthansa	15
Singapore Airlines	9
British Airways	8
Malaysian Airways	7
Alitalia	7
Air France	5
Garuda	5
Swissair	5
Iberia	0.6
Scandinavian Airlines	0.4
Other Airlines	23

The list of 'Other Airlines' accounting for 23% of the total included: China Airlines, Air Mauritius, El Al, Kenyan Airlines, Aeroflot, Cathay Pacific, Iran Air, Air Portugal, Air Lanka, Thai Air, Varig, Martinair, American Airlines, Virgin, South African Airways, Emirates and Sabena.

7.5 Approximate European Veterinary Inspection Fees (US $*)

Belgium: No charges at the moment, pending the construction of a veterinary inspection centre at Brussels airport.

Denmark: 42 up to 1,000kg - any species.

France: 32 up to 500 kg - any species.

Germany: 30 - no weight limit - any species.

Holland: 30 - any species - for 100kg and up to 70 for 500kg.

Italy: 16 - any species - up to 500kg - 54 for all amounts (no limit) above this.

Portugal: 29 - any species - up to 500kg.

UK: 8 minimum for 100kg - any species -followed by c.50 cents per box.

*The above figures are approximate, since they are affected by numerous factors, including exact weight of boxes, numbers of fish per box, currency exchange fluctuations,etc. They must be therefore only be

regarded as broad indications which should, nevertheless, allow general comparisons to be made.

**As from January 1999, the Spanish rates have been reduced by 90%.

7.6 Sanitary norms certification availability

Australian quarantine policies on imported fish and fishery products are one of the most strict in the world and because of contamination problems in several imported stocks, the Australian norms will very soon become an accepted international requirement. This report will therefore use the Australian policy as model.

Ornamental or aquarium fish are currently the only live species routinely permitted into Australia; however, in line with recommendations made by the Bureau of Resource Sciences and the National Taskforce on Fish and Fish Products, the Australian Quarantine & Inspection Service

(AQIS) is examining ornamental finfish importation policy to strike a reasonable balance between minimizing the risks of exotic pathogen entry and meeting its obligations to international trading partners, including that its quarantine measures are scientifically justified.

AQIS's recommendations will take into consideration the concerns of industry, government agencies and others. Several issues will need to be considered, among them the need for laboratory/diagnostic support; use of antibiotics and other treatments during quarantine; differentiation between Australian strains of pathogens and those that occur overseas; the adequacy of existing quarantine practices for freshwater ornamentals; and whether the requirements for marine ornamental fish should be substantial different to those used for freshwater ornamental fish.

As a part of the risk analysis process AQIS will address three fundamental questions:

1./ the likelihood of an imported fish carrying an exotic pathogen;

2./ the probability of that pathogen escaping into the environment and establishing; and

3./ the amount of harm that could be caused by its establishment.

Having addressed those questions, Australia must then decide what measures need be applied to ensure that the risk of establishment is acceptable. This task will require co-operation between industry, government agencies and the public.

Both overseas exporters and local importers must be approved, and all shipments are inspected at the port of entry and monitored over a 14 day quarantine period (28 days in the case of gouramis). Marine fish are inspected on arrival.

The importance of fish diseases and their threat to fisheries and aquaculture has been acknowledged by the World Organisation of Animal Health, which in 1995 published the *International Aquatic Animal Health Code* incorporating a list of notifiable diseases. Listed diseases not recognised as endemic to Australia include: infectious haematopoietic necrosis, spring viraemia of carp and viral haemorrhagic septicaemia. Most of the serious pathogens of fish are believed to be exotic to Australia. For those pathogens that have been recorded, the virulence of the Australian strains is often lower than for those described from overseas. Examples include lymphocystis virus, *Yersinia ruckeri* and *Aeromonas salmonicida*. In an extensive review of aquatic animal quarantine, the Bureau of Resource Sciences identified three species of freshwater ornamental fish (goldfish, guppies and gouramis) to be high risk in terms of their capacity to harbour pathogens. Goldfish, the most commonly imported fish, has been associated with harbouring several important fish pathogens including *Y. ruckeri, Edwardsiella tarda* and infectious pancreatic necrosis virus.

Whatever the magnitude of risk, shipments of live fish have in the past been associated with introduction of exotic pathogens. There are several cases cited in the literature, including in Australia, where for example *Aeromonas salmonicida nova* (the agent of goldfish ulcer disease) was reportedly introduced with goldfish from Japan.

Source: Australian Quarantine & Inspection Service

7.6.1 Conditions for the importation of live freshwater ornamental fish into Australia

(a) All fish in the consignment must be packaged in leakproof bags, each bag containing only **one** species. The bag must be sufficiently transparent to enable proper inspection and identification of the fish. Use of "double bagging" is recommended to minimise leakage where damage due to fish spines may occur. **Each bag** must be clearly and correctly labelled with an individual bag identification, and/or with the scientific name of the contained fish.

(b) The bags must be placed within cartons fitted with a plastic lining. Each carton must be clearly identified by invoice number and identification number. No carton in the consignment may weigh more that eighteen (18) kilograms or exceed 0.07 cubic metres.

(c) Papers attached to the invoice must include for each bag the scientific name and number of each type of fish and, if the bags are only labelled by number, the corresponding bag number. It is recommended that the common names of the fish is also used.

(d) The fish must not be overcrowded and must have been subjected to a water change on more than one occasion during the period of 14 days prior to export, and, when packed for export, must be placed in water of a quality suitable for drinking. Use of a pH indicator in the water is permissible, provided it does not interfere with identification of the fish and determination of their health status.

(e) The consignment must only include fish that are sufficiently mature to permit accurate identification. Only fish on the approved list are to be included in the consignment. No plant material or animal, other than the approved fish, is to be included.

(f) All fish in the consignment must have been examined and the exporter must be satisfied that no signs of ill health have been observed, and that he/she must ensure that the stock of fish from which they are drawn are apparently free from disease.

(g) Any fish in the consignment which have been imported from another country

must be held in the exporting country for more than 14 days prior to the date of export to Australia, and the details of such transactions must be attached to the import permit.

(h) In the event that goldfish (*Carassius auratus*) are included in the consignment, the farm(s) of origin of the goldfish must be known to be free from goldfish ulcer disease (*Aeromonas salmonicida* infection). Additionally, all consignments of goldfish must be accompanied by a certificate issued by a government official of the exporting country with an appropriate knowledge of fish health and the exporting premises attesting that the goldfish in the shipment have been examined and show no clinical evidence of disease, and that the goldfish originate from a country considered free from spring viraemia of carp (SVC) or from premises at which there has been no evidence of the presence of SVC for the three months immediately prior to shipment. The certification for the health of the fish in the shipment and freedom from disease relates to an examination for clinical signs of disease and takes into account the results of any testing that may have been done. Specific health testing of the fish is not required unless it is indicated by the particular circumstances.

The export premises certification for SVC must take into account all relevant information, including observed disease occurrences and their investigation, the source of any fish on the export premises that are carriers of SVC virus, scientific reports and notification.

(i) The consignment (including packaging) will be examined at port of entry by fish quarantine inspectors who will confirm that all documentation is in order, that only approved species are included, that no material of quarantine concern is present and that all the fish are healthy.

URL: http://www.aqis.gov.au/docs/anpolicy/afreornf_9.htm

7.6.2 Quarantine

All freshwater ornamental fish intended for entry into Australia are subject to a number of quarantine requirements.

a. An exporter's declaration must accompany each shipment. The fish must be

healthy and have been resident in the country of export for a period of at least 14 days prior to export.

b. All consignments of goldfish (*Carassius auratus*) must be accompanied by a certificate issued by a government official of the exporting country with an appropriate knowledge of fish health and the exporting premises attesting that the goldfish in the shipment have been examined and show no clinical evidence of disease, and that the goldfish originate from a country considered free from spring viraemia of carp (SVC) or from premises at which there has been no evidence of the presence of SVC for the three months immediately prior to shipment.

c. The fish will only be eligible for importation into Australia from approved pre-embarkation fish premises in the country of export. These pre-embarkation fish premises must be approved on a six monthly basis by the government veterinary authority of the exporting country. All freshwater ornamental fish must meet the specified conditions for entry to Australia and will be ordered into quarantine to undergo a minimum period of 14 days quarantine in approved quarantine premises. A minimum of 28 days quarantine is required for gouramis. During the quarantine period in Australia, each fish may be subject to any tests and treatments as may be required by the Director.

e. Import quarantine premises will only be approved, as a place for the performance of quarantine of live fish under Section 46A of the *Quarantine Act*, when they meet AQIS standards.

The standards for import quarantine premises are under AQIS operational work instructions issued from time to time. All quarantine premises nominated for use must be approved by the Chief Quarantine Officer (Animals) before any import permits are issued and/or renewed. The import permit may be cancelled or suspended by the Director of Animal and Plant Quarantine (Australia) if the quarantine standards are not maintained.

Note 1: In the event of any imported fish producing a positive result to any tests undertaken at the quarantine facility, the Director of Animal and Plant Quarantine (Australia) may cause any or all of the fish to be either detained in quarantine for further testing or destroyed.

Note 2: If any fish are destroyed during any period of quarantine, compensation will not be paid by the Government. Costs of any quarantine, test or treatment will be borne by the importer.

Source: http://www.aqis.gov.au/docs/anpolicy/afreornf_3.htm

8 Technical Feasibility

8.1 Site Suitability

The primary criteria for the site is the ambient temperature throughout the year. All the potential subjects for this concern are tropical and temperature should not be allowed to drop below 20°C. The temperature regime of the site should be known for a number of years. If there are chances of the temperature dropping below 20°C, culture should be done indoors. Other important criteria for the site are the distance from the airport (for the export market), the quality of the road between the site and the drop-off point (so as to minimise stress on the packed fish) and availability of electricity and clean water

8.2 Water suitability

The water for the farm should ideally be as close to the source as possible so as to avoid contamination by fertilisers, pesticides and industrial effluents. If a site shows ideal characteristics except for the water source, it can still be possible to transport spring water to the farm and to use a recycling system for the wastewater.

The water on the farm should be free from pathogens (viruses, bacteria, fungi, protozoa and eggs of larger animals). It should therefore be filtered and UV treated prior to use.

8.3 Availability of expertise

Inquiries with aquarium shop owners and edible fish aquaculturists have indicated that specialised expertise for ornamental fish culture is not presently available in Mauritius. For the implementation of the project, it will be essential to either hire an experienced technician/scientist from one of the far east countries or to send one Mauritian for training abroad.

8.4 Equipment required

Some of the basic equipment, like tanks and air/water pumps are available on the local market. Mechanical and biological filters, electronic monitoring equipment and UV sterilizers need to be imported. All commercial aquaculture equipment are available from

(1) Aquatic Eco-systems Inc, 1767 Benbow Court, Apopka, Florida 32703-7730, USA (WebSite: http://www.aquatic-eco.com) Fax: 407-886-6787

(2) J.L.Eagar, Inc, P.O Box 540476.526 North 700 West, North Salt Lake, Utah 84054, USA. Fax: 801-295-7569

(3) Keeton Industries, Inc, 300 Linciln Court Fort, Collins CO 80524, USA. Fax: 970-493-4921

8.5 Technical Set-up

It is proposed that the farm will have an annual production of 2,000,000 units. At a stocking density of 200 fishes per metre cube of water, the water holding capacity of the farm should be 10000 metre cube. The farm will therefore have 1000 fibre-glass tanks of 10 metre cube capacity each (Diameter of 3.6 metres x height of 1 metre). The spread of the farm will be 16,000 square metres (1.6 hectares). Some of the tanks holding juveniles will be kept under sheds while those holding adults of more hardy fishes can be kept in the open

Identified Site

A site has been identified near the Rose Belle sugar factory for the pilot project. It is an abandoned maize processing plant belonging to the company. All machinery have been removed and it presently consists of a high roof hall with about 145 square metres of floor space including two rooms of 10 square metres each. A pilot farm having a production capacity of about 1% of a full fledged farm can be set up at this site

9 Economic Feasibility of full-fledged farm

9.1 Initial Costs

ITEM	COST (Rupees)	ECONOMIC LIFE IN YEARS	SALVAGE VALUE	ANNUAL DEPRECIATION (Rupees)
Building	3,000,000	100	Nil	30,000
1000 Fibre-glass tanks	10,000,000	20	1,000,000	450,000
Water supply system	500,000	20	Nil	25,000
Air compressor & aeration system	200,000	5	Nil	40,000
Lighting system, UV steriliser	300,000	20	Nil	150,000
Filters, Monitoring & laboratory equipment	400,000	10	10,000	39,000
Water pump	200,000	5	Nil	40,000
Office equipment	300,000	10	10,000	29,000
Contingency	1,500,000			000,000
Stand-by generator	100,000	5	10,000	18,000
Vehicle	500,000	5	100,000	80,000
TOTAL	17,000,000			901,000

9.2 Annual Operating Costs

9.2.1 Variable costs

ITEM	QUANTITY	UNIT PRICE (Rs)	TOTAL COST (Rs)
Feed + additives	200 tonnes	25	5,000,000
Electricity	100,000 KwH	3	300,000
Water	20,000 m^3	10	200,000
Chemicals	-	-	100,000
Others	-	-	900,000
TOTAL			6,500,000

9.2.2 Fixed costs

ITEM	QUANTITY	UNIT PRICE (Rs)	TOTAL COST (Rs)
Land lease			60,000
Depreciation			901,000
Maintenance			1,000,000
Consultant Biologist	1	1,300,000	1,300,000
Biologist	4	500,000	2,000,000
Helpers + Administrative staff	20	100,000	2,000,000
Interest on loan (12%)			1,200,000
Contingency			1,500,000
TOTAL			9,961,000

TOTAL RECURRENT EXPENDITURE: Rs. 6,500,000 + 9,961,000= Rs.16,461,000

9.3 Income

ITEM	PRODUCTION	UNIT PRICE in Rs	ANNUAL INCOME in Rs
Fish	2,000,000 units	10 (mean)	20,000,000

9.4 Farm Performance Indicators

Profit: = Rs. 3,539,000

Rate of return on initial cost = 20.8 %

Rate of return on operating cost = 21.5 %

Break-even average price = Rs. 8.23 (mean per unit)

Break-even production = 1,646,100 units

10 Economic Feasibility of pilot farm

An economic feasibility for a pilot farm using the above methodology has been tried assuming an initial funding of Rs1,000,000. Of these Rs.500,000 is used in capital expenditure and another Rs.500,000 goes in fixed and variable recurrent expenditure. However, in spite of the scaling down of the operations, the fixed costs remains relatively high because of the cost a foreign consulting biologist whose value will not change considerably with the scaling down of the operation. In the calculations below, the cost of the consultant has been removed and it is assumed that it can be recruited from other sources of funding (TIDS or bilateral co-operation programme). With such a scenario, the farm will just break even in the first year of operation

It should however be remembered that the project is perfectly viable on a large scale. The problem arises only in the case of the scaled down pilot phase. The table below gives the breakdown of expenditures and profits for the pilot phase.

Economic Feasibility of pilot farm				
Initial Costs				
ITEM	COST (Rupees)	ECON LIFE	SALVAGE	DEPRECIATION
Adaptation of existing building	50,000	50	Nil	2,000
20 Fibre-glass tanks	200,000	20	50,000	4,000
Water supply system	50,000	20	0	7,500
Air compressor & aeration system	30,000	5	5000	5,000
Lighting system, UV steriliser	30,000	20	0	1,500
Filters, Monitoring & laboratory equip	40,000	10	0	4,000
Water pump	10,000	5	0	2,000
Office equipment	0	0	0	29,000
Contingency	40,000			
Stand-by generator	50,000	5	10,000	8,000
Vehicle	0	0	0	0
TOTAL	500,000			63,000

Annual Operating Costs				
Variable costs				
ITEM	QUANTITY	UNIT PRICE	TOTAL COST	
Feed + additives	2 tonnes	25,000	50,000	
Electricity	1000 KwH	3	3,000	
Water	200 m3	10	2,000	
Chemicals	-	-	1,000	
Others	-	-	9,000	
TOTAL			65,000	
Fixed costs				
ITEM	QUANTITY	UNIT PRICE	TOTAL COST	
Land lease			0	
Depreciation			63,000	
Maintenance			10,000	
Consultant Biologist	1	Not included	Not included	
Biologist	1	300,000	300,000	
Helper (Part time)	1	20,000	20,000	
Interest on loan (12%)			0	
Contingency			42,000	
TOTAL			435,000	
TOTAL RECURRENT	65,000	Plus 435,000	= 500,000	
9.3 Income				
ITEM	PRODUCTION	UNITPRICE	INCOME	
Fish	50000 units	Rs.10 (mean)	Rs. 500,000	

11 Conclusion

This study has shown that the proposal for starting an ornamental fish breeding unit for the export market is feasible in Mauritius. If this industry has not yet been started in Mauritius, it is because:

- entrepreneurs are not aware of the returns on their investment in this business
- of low-availability of expertise in this specialised field

It should however be mentioned that importers are not interested in buying one or two species only from a foreign supplier because a small order is not cost-effective. If an ornamental fish farm is to develop in Mauritius, it should be able to provide most, if not all, of the species which are regularly ordered by large retail suppliers. Most large retailers already have their wholesale suppliers and if they are going to shift to a new supplier, the service, in terms of quantity, quality (sanitary norms, hardiness, colour) and efficiency should be superior to that of existing suppliers.

The industry in Mauritius should, therefore, provide most species which are on demand. If there is going to be a pilot phase, it should **not** restrict itself to a few species but should produce all the potential species mentioned in this report. The pilot phase could however, restrict itself to supplying only one or two wholesalers at the beginning. The local market is very restricted; it absorbs only around 200,000 units which represents one tenth of the capacity of the proposed farm. Any production surplus could be sold on the local market in order to popularize fish keeping as a hobby.

Because of the risks involved in a pioneer industry (which depends on the biology of a species for its success) it is essential for the industry to recruit an experienced consultant to manage the production on the farm

The project is feasible and in fact should be considered as an important potential foreign currency earner for Mauritius in the years to come.