Sustainability and Consumer Preference of Wild Caught Ornamental Fishes from Kerala: Scope of Certification

Thesis submitted to the
Cochin University of Science and Technology
for the award of the degree of
Doctor of Philosophy

By

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Under the Supervision of
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May 2014

Dedicated to

My parents, husband and daughter...

DECLARATION

I hereby declare that the present work entitled **"Sustainability and Consumer Preference of Wild Caught Ornamental Fishes from Kerala: Scope of Certification"** *is the outcome of the original work carried out by me under the supervision and guidance of Prof. Dr. A. Ramachandran, School of Industrial Fisheries, Cochin University of Science and Technology, in partial fulfilment of the requirements for the PhD degree of Cochin University of Science and Technology and that the work did not form part of any dissertation submitted for the award of any degree, diploma, associateship or any other title or recognition from any University or Institution.*

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ACKNOWLEDGEMENTS

It is with profound joy that I express my heartfelt gratitude to my supervising guide and mentor Prof. Dr. A. Ramachandran, School of Industrial Fisheries, CUSAT, for his inspiring and excellent guidance, valuable suggestions, ceaseless encouragement and intellectual support. His thoughtful insights have often spurred me on to explore new avenues of scientific knowledge.

I keep in record my sincere gratitude to Dr. N. Mini Sekharan, Assistant Professor, School of Industrial Fisheries, CUSAT for her support, encouragement and valuable comments. The academic discussions I had with her helped me a lot to give form to my ideas and thoughts. I wish to thank all teachers at the School of Industrial Fisheries, CUSAT, for their encouragement and support. The office staff of this School has always lent me their timely assistance which helped me to finish my work here without any hassles, and I am indeed grateful to them for it. I am indebted to the library staff of the CUSAT Marine Sciences Library, Central Library and School of Management Studies Library.

I wish to thank Sri. H. Krishna Iyer former scientist, CIFT, Dr Sunosh, Statistical Department, CUSAT and Dr. Jeevanand for all

the statistical help and encouragement. I sincerely thank Dr. M. Krishnan, Head, Social Science Division, CIFE, Mumbai, for sparing his precious time and responding to my queries and offering me timely help. I am grateful to Dr. Nikita Gopal, Senior Scientist, CIFT for paving a ray of hope when i was totally blank with my work.

I am grateful to the managements of all the firms I surveyed and also the stakeholders including the fishermen, ornamental fish dealers and exporters for giving me their valuable time, information and useful comments. I am thankful to the staff of KAVIL and MPEDA especially the staff of ornamental fish division and marketing division for all the support they have lended to me.

Just decorative words are not sufficient to express my love, gratitude to my dear friends who have not only supported me through their healthy criticism but also have made my difficult times lighter through their presence. I would like to remember my dear friends Aneesh, Sindhu, Soumya Subra De, Asha, Antony, Roseline, Baiju, Liji, Anupama, Diana, Anjali, Jenson, Deepak, Renjith and Roshni. There is no need of formal thanksgiving to the people who revolve around my life-my parents, my brother, my husband, and my little princess cuckoo whose presence is the biggest strength and weakness in my life.

CERTIFICATE

This is to certify that the thesis titled **"Sustainability and Consumer Preference of Wild Caught Ornamental Fishes from Kerala: Scope of Certification"** *is an authentic record of the research work carried out by Ms. Liya Jayalal under my supervision and guidance at the School of Industrial Fisheries, Cochin University of Science and Technology, in partial fulfilment of the requirements for the degree of Doctor of Philosphy and no part thereof has been submitted for any other degree at any other institution.*

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This is to the effect that all the relevant corrections and modifications suggested by the audience during the pre-synopsis seminar and recommended by the Doctoral Committee of Ms. Liya Jayalal, full time research scholar, School of Industrial Fisheries, Cochin University of Science and Technology has been incorporated in the thesis.

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Abbreviations

AD	:	Anno Domini
ALOP	:	Acceptable Level of Protection
AMRL	:	Archipelago Marine Research Ltd.
Brazilian MoF:		Brazilian marine ornamental fish
CEC	:	Commission for Envronmental Cooperation
CITES	:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CoC	:	Chain of Custody
DNA	:	Deoxyribonucleic acid
DOA	:	Dead On Arrival
EPO	:	European Pet Organization
EU	:	European Union
FAO	:	The Food and Agriculture Organization
FFSG	:	Freshwater Fish Specialist Group
GI	:	Geographical Indication
GoI	:	Government of India
HCV	:	High Conservation Value
ISO	:	International Organization for Standardization
IUCN	:	the International Union for Conservation of Nature
LRFFT	:	Live Reef Food Fish Trade
MAC	:	Marine Aquarium Council
MPEDA	:	Marine Products Export Development Authority
MSC	:	Marine Stewardship Council
NAAS	:	National Academy of Agricultural Sciences

NACA	:	Network of Aquaculture Centres in Asia-Pacific
NE	:	Nordic Ecolabel
NOAA	:	National Oceanic and Atmospheric Administration
OECD	:	Organisation for Economic Co-operation and Development
SPS	:	Sanitary and Phytosanitary Measures
SWOT	:	Strengths, Weaknesses, Opportunities and Threats Analysis
UNCLOS	:	United Nations Convention on Law of the Sea
UNEP	:	The United Nations Environment Programme
USD	:	United States Dollar
WCED	:	World Commission On Environment And Development
WIPO	:	World Intellectual Property Organization
WWF	:	World Wildlife Fund

CHAPTER 1

GENERAL INTRODUCTION

1.1 Introduction

"The history of man's effort to subjugate nature is also the history of man's subjugation by man"

– Max Horkheimer

Man is a part of nature, with which he interacts constantly and reflects in himself the slightest oscillations within it. Nature has been an integral part of man's festivals, rituals and cultures throughout the stages of his evolution. Man's immense dependence on nature necessitated that he alters or changes it to suit his needs.

1.1.1 Early human impacts on environment and conservation measures

Human impact on the environment can be traced back over many centuries. According to Choquenot and Bowman (1998) and Johnson and Prideaux (2004) evidence suggesting towards a significant human contribution to environmental changes were there even during the Late Pleistocene age. Such instances also occurred during early Holocene in Caribbean islands (Steadman *et al*., 2007) and during late Holocene in Pacific islands and Madagascar (Kirch and Hunt, 1997).

The severity of the human actions on the environment led to the enactment of certain informal and formal rules and regulations. In the 11th Century, Norman Kings of England passed laws to restrict hunting in forests (Rickets, 2011). In AD 80, Senate of Rome passed legislation to protect the city's supply of clean water for drinking and bathing. In 14th Century England, laws were passed against disposal of waste water into waterways. In 1681, the Quaker leaders of the English colony of Pennsylvania ordered that one acre of forest be preserved for every 5 acres of land (Cheever and Mohn, 2007). The conservation efforts triggered debates

regarding the role of government in managing resources in 1811 in Africa (Sim, 1907 and Grove, 1995).

1.1.2 Initial conservation measures in fisheries

The earliest recorded conservation measures for fisheries are found in the 14th Century when a petition was presented to the Parliament calling for the prohibition of wondychrome, an early beam trawl (Collin and Collin, 2010). In 1493, Pope Alexander VI attempted to set up the artificial oceans rule. Its lack of effectiveness led to the formation of Freedom of Seas Principle which came into being during 17th Century (de Fontaubert *et al.*, 2003). In 1871, the US Fish Commission was setup. It was the first official government action involving conservation of renewable resources (Guinan and Curtis, 1971). In 1958 and 1960, UNCLOS I and UNCLOS II came into being (Pratt and Schofield, 2000). In 1972, during the Stockholm conference, the Declaration of Principles on the Human Environment was adopted (Holdgate *et al*., 1982). In the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora was formed. It was in 1987, the Brundtland Commission put forward a whole new concept of

conservation, which is known as the sustainable development.

1.1.3 Sustainability and Market Based Incentives

According to Grober (2007), the term 'sustainable' was first introduced into a political language in 1972 by Club of Rome. Club of Rome published a report titled 'Limits of Growth' where the term sustainability was used to describe the desirable "state of global equilibrium". The most widely used and well-known definition of sustainable development is: "Sustainable development is development that meets the needs of the present without compromising the needs of future generations to meet their own needs (WCED, 1987). According to Pearce *et al.* (1989) sustainable development involves devising a social and economic system which ensures that these goals are sustained, that is, real incomes rise, educational standards increase, nation health and health care standards improves and general quality of life increases. Sustainability can also be defined as leaving for future generations "the option or the capacity to be as well off as we are" (Solow, 1991). The perspectives of sustainability have varied across time. Initially, sustainability was explained

using simple approaches like recycling, use of wind turbines, hydroelectricity and nuclear energy (WWF, 2008). But later at Earth Summit in 1992 emphasis was given to market based incentives like ecolabeling and certification and their potential usefulness was discussed (Panjabi, 1997). Later Blewitt (2008) stressed on more complex solutions to sustainability like Life cycle Assessment, Ecological Footprint Analysis and Dematerialization.This thesis focuses on market based incentives and the following sections shall discuss the same.

Studies on Market Based Incentives (MBI's) show that taxes, fees and charges can be seen as approaches which are useful in limiting damage to existing biodiversity. Eco-labelling and the like can help foster increased protection to biodiversity and enhance its quality (Brauer *et al.*, 2006). The Blue Angel is the first and oldest environment-related label for products and services in the world. It was created in 1978 with the initiative of the German Federal Minister of the Interior and was approved by the Ministers of the Environment of the Federal Government and the Federal States (Frankl *et al.*, 2005; Boström and Klintman, 2008; Parkes *et al.*, 2009). It considered itself as a market-conforming instrument of environmental policy that was designed to identify positive environmental features of

products and services on a voluntary basis. Bogdan (2010) noted that today nearly 400 ecolabels exist for various products.

1.1.4 Introduction of ecolabels and certification to maintain sustainability in fisheries

Globalisation has made it difficult for national governments to impose their domestic trade regulations without affecting the international trade relationships (Kastner and Pawsey, 2002). National Governments trying to impose stringent measures on their domestic fisheries and imported fisheries products fail to secure a safe and economically viable position in the international trade (Konefal *et al.,* 2005). Hence in this context instruments such as private labels and certification schemes are increasingly preferred which convey the information without the buyer necessarily having to comprehend the details of the product (Oosterveer, 2010).Washington and Ababouch (2011) have analysed ecolabels, food safety and quality standards and their importance for a range of stakeholders. They addressed issues that were driving the development of ecolabels and examined *inter alia* their policies and governance

implications, impact on costs, role in traceability, the assessment of their credence, and the challenges and opportunities for developing countries. Ramachandran (2010) provides a brief note on the various conservation standards and guidelines for conservation of marine ornamental fishes and also highlights initiatives for conservation of fresh water ornamental fishes. Despite proponents for certification vowing to maintain sustainability in fisheries through certifications, numerous studies emerged that exhibited the failures and problems concerned with certification. Ward (2008) expresses in his study that MSC was a poorly implemented environmental standard which resulted in various interpretations by certifiers and created an apparent bias. Additional problems related to fisheries certification were like fisheries being common property and being under multiple jurisdictions leads to problems in assessing the compliance of fisheries with sustainability certifications (Kaiser and Jones, 2005). Biologists were also reluctant to get involved with the certification process as they lacked confidence in its ability to bring out sustainable production. Also, they faced conceptual and practical difficulties in developing guidelines for determining and assessing biological concerns (Ghazoul, 2001). Sutton (2003) also criticises the second principle of MSC for being broad

and highly aspirational and not likely to be achieved by any wild capture fisheries. But studies also suggest that if certification creates tangible values (Anon, 2002) and does not create barriers for trade or acts as a protective cover for domestic trade (Deere, 1999) then it can be successful. There are traditional players like governments and regional fisheries management organizations and environmental and non-profit groups who have become active in sustaining the fisheries resources through eco-certification and sustainability ranking programs. Shelton (2009) is of the view that presence of both the players in the conservation scenario can cause confusion with regard to who should be determining whether a fishery is sustainable with the cost of possible redundancy being ultimately borne by the public. The study concludes with the recommendation that both the players should adopt "belt and brace" approach for the time being.

1.1.5 Ornamental fish trade and sustainability

Ornamental fish industry is one that developed because of the evolution of a popular hobby. Though the global ornamental fish trade is relatively small, it makes significant contributions to the trade of freshwater and marine aquatic

products. The estimated retail worth of global ornamental fish trade is more than USD 8 billion (Silas *et al.*, 2011) while the annual trade volume was estimated to be USD 15-25 billion (Ploeg, 2009). From the start of the new millennium, the world export trade has showed an annual compounded growth rate of 6.2% (Tissera, 2012), while Ploeg (2013) has highlighted a clear drop of 11% in world exports volume from 2008 to 2009 and a drop of 13% in world import volume from 2009 to 2010. Aquarium fishes are both wild caught, and captive bred at aquaculture facilities, with over one billion fishes traded through more than 100 countries during 2000 (Whittington & Chong, 2007). According to Rana (2007) Singapore continues to be the biggest exporter and also remains the Asian hub for ornamental fish. But recent reports have another story to tell. Spain is strongly emerging as the biggest exporter of ornamental fish in the world. According to Fossa (2012), the reports of export value of ornamental fish during the period 2000-2009 show Spain taking second position next to Singapore while the latest report by Ploeg (2013) shows that Spain has overtaken Singapore and became the biggest exporter of ornamental fish in the world. Japan, Malaysia, Czech Republic and Thailand are the other major players in the world ornamental fish exports (Fossa, 2012). The United

Kingdom and The United States are the biggest markets for Singapore, together which accounts for nearly 30% (Tissera, 2012).

India holds 29th position in the global ornamental fish exports (Fossa, 2012). It stands way back in the ornamental fish trade with an export worth USD 1.17 million during 2009-2010 (Nair, 2012). The prospects of Kerala in ornamental fish trade can be explored through the works of Ramachandran (2002 a and b), Harikumar (2006), Sekharan (2006), Shyma (2008), Kurup and Antony (2010). During 2010-2011 as per the quantity exported, according to the port wise exports, Kolkata took first position, while Kerala took the second position (Nair, 2012).

Marine aquarium trade has raised concerns due to the unsustainable harvesting methods for aquarium trade, poor handling and husbandry practices and potential for over-exploitation in the last decade (Johannes and Riepen, 1995; Barber and Pratt, 1997; Sadovy, 2002; Schmidt and Kunzmann, 2005). Aquarium trade is mainly concentrated around tropical freshwater fish species, which are mainly collected from the wild and only 10% are captive bred (Olivier, 2001 and Silas *et al.*, 2011). Andrews (1990) has described about the negative impacts of ornamental fish trade stressing on the introduction of non-native aquatic organisms

through the international and intercontinental movement of aquatic organisms for trade and also depletion of wild stock. McDowall (2004) again stresses on the impact of aquarium trade in introducing non-native invasive species thereby importing diseases in New Zealand. Padilla & Williams (2004) have mentioned in their study that aquarium releases are the second largest source of introduced fish in US and 1/ 3rd of aquatic nuisance species that currently threaten aquatic ecosystems originate from the aquarium and ornamental species trade. Rhyne *et al*. (2012) has discussed the lack of a data system for monitoring the wildlife aquarium trade and analysed problems arising due to it. Their study is the first on aquarium trade imports, comparing the commercial invoices to government forms for analysing the relationship between trade volume, biodiversity and introduction of non-native marine fishes. Besides these issues, there are many other concerns relating to the ornamental fish industry which is discussed in detail in the review section. Raghavan (2010) has frequently mentioned in his work about the unregulated, open-access aquarium trade in India, which has resulted in threatening the existence of many indigenous fresh water ornamental fish species. India is blessed with two biodiversity hotspots - the Eastern Himalayas and the Western Ghats- that foster the major needs of Indian ornamental fish industry

(Molur *et al*., 2011). By highlighting the endemic freshwater ornamental fish species being exported from India, Raghavan *et al.* (2013) has opined that local regulations on aquarium fish collection and trade are poorly enforced.

1.2 Relevance of the study

Though ornamental fish industry has a significant place in the global trade, the industry hasn't made an impetus equal to food fish sector. It would be unwise to consider this hobbyists preferred industry to match the food fish sector. But the sustainability issues raised by this industry are equally significant as any other trade related sustainability threat. There have been little studies relating to the sustainability concerns of the aquarium trade. Most of the studies have been done in the marine ornamental fish sector. The present work would be the first of its kind trying to analyse the sustainability concerns and the effect of proposed certification on the freshwater ornamental fish industry. As MPEDA, is about to rollout the Green Certification scheme, this work can be considered as a pilot study.

1.3 Scope of the study

- Identifying the sustainability issues in the chain of custody of wild-caught ornamental fish
- Serve as a material for awareness program for the stakeholders as well as a pilot study to the Green certification program
- The cost adaptability study will serve as an insight to the cost of adopting the guidelines laid down in the Green Certification guidelines.
- Attempts to find the consumer preference for certified freshwater fish, thereby helping to develop suitable marketing strategies.

1.4 Objectives

The objectives of the study are:

- To identify the various species of indigenous fish exported from India
    - To study the export trend of Indian ornamental fish industry
    - To find the production function analysis of the export firms in India

- To study the impact of the present state of wild caught ornamental fish on the sustainability of the resource.
  - To find the major sustainability issues along the chain of custody of wild caught ornamental fish exported from Kerala
  - To list the suitable sustainability indicators and criteria for the wild caught indigenous ornamental fish exported and also to find the interactions and linkages for the indicators.
  - To compare the sustainability assessment of the three major exported wild caught indigenous species which are, *Tetraodon travancoricus*, *Dario dario* and *Puntius denisonii*, from India.
  - To analyse the effectiveness of the Kerala Government Order on conserving *Puntius denisonii*.
- To find the impact of introduction of a certification scheme for wild caught indigenous fish exported from India.
  - To study the compliance cost, that may be incurred while adopting the certification- A case study method using Green certification.

- To predict the environmental impact of Green Certification by measuring the attitude of stakeholders.
- To study the consumer preference of certified freshwater ornamental fish

1.5 Limitations

- It was difficult to conduct all India survey, and hence the work has relied on e-mail survey method.
- The sample size for the certification impact study was small, as the survey was conducted only among the fishermen and exporters in Kerala.
- Convenient sampling method was adopted for the consumer preference study, as the study was conducted using e-mail survey sent to a hobbyist forum. The number of respondents who responded positively to the survey was small and hence the result may not be true for a larger population.
- Availability of limited literature on certification in fisheries.
- Non-cooperation towards survey.
- Lack of official records on the ornamental fishermen affected the precision of facts and figures.

1.6 Plan of the study

Chapter 1

The chapter gives an overview, relevance and scope of the study and peeps into the studies that paved way for the study.

Chapter 2

The chapter speaks about the research methodology adopted for the accomplishment of the work.

Chapter 3

The chapter deals basically with the export trend listing the major ornamental fish species being exported by India. It also looks into the growth rate and also tries to analyse the efficiency of the export firms using production function.

Chapter 4

The chapter raises the major sustainability issues that are present along the chain of custody of wild caught fresh water ornamental fish exported from Kerala. Sustainability criteria and index were developed for the wild caught fresh water ornamental fish exported from Kerala and was mapped to find out the most important sustainability issue. The

chapter also highlights the flaws of a not much studied regulation for conserving *Puntius denisonii*.

Chapter 5

The chapter speaks about the impact of a supposed certification in the freshwater ornamental fish sector.

Chapter 6

The chapter attempts to find the consumer preference of the certified freshwater ornamental fish among the aquarium hobbyists.

Chapter 7

The last chapter gives the summary of the results of each preceding chapters and also puts forward certain recommendations.

1.7 Review of literature

1.7.1 Efforts towards ensuring sustainability of fisheries with special reference to ornamental fish

Cheonge (1996) has discussed the value of international export and import of ornamental fish and has highlighted the fact that between 1983 and 1992 the annual growth of imports and exports averaged 21% and 16% respectively. The same work has also elaborated on the importance of treatment of ornamental fish prior to export to ensure quality by minimising stress and disease transmission. Davenport (1996) makes a detailed appraisal of the sources of supply and the destination for imports into EU Member States. The methods of transport and the chain of supply of ornamental fish to the hobbyist in the EU are also examined. Wabnitz *et al.* (2003) has elaborated on the marine ornamental fish, coral and invertebrates used in the trade. The work also brings out the fact of using those species in the trade which are not known to acclimatize with the aquarium conditions. The study opines of making use management measures like third-party certification, quotas and size limits and restricted access to fish through methods

like using permits and establishment of areas closed to fishery. The study also stresses on the need for procuring basic information like life history and characteristics of the fish species used in ornamental trade.

Whittington and Chong (2007) elaborated in their study about the failure of risk analysis and quarantine controls that are applied in accordance to the Sanitary and Phytosanitary agreement (SPS) in Australia. The stringent quarantine policies for imported ornamental fish are based on import risk analysis under the SPS agreement but have not provided an acceptable level of protection (ALOP) consistent with government objectives to prevent introduction of pests and diseases, promote development of future aquaculture industries or maintain biodiversity. The author recommends a reduced number of species traded and the number of sources permitted to facilitate hazard identification, risk assessment and import quarantine controls. Steinke *et al.* (2009) , as a means of ensuring sustainable harvesting and to know point of origin by identifying specimens, has assembled a DNA barcode reference sequence library for nearly half of the ornamental fish species imported into North America. Duggan (2010) describes in his study about the "incidental" transport and introduction of invertebrates as result of freshwater aquarium trade. Most of these incidentally

transported species were non-native. The work recommends on a better managed disposal of aquarium wastes and stresses on the common method of disposing onto garden. Oidtmann (2011) stresses on the effective biosecurity strategies that minimises the risk of introducing pathogens and minimises the consequences of the introduced pathogen to both farmed and wild aquatic animal populations. Collins (2012) has also highlighted the importance of DNA barcoding as a potentially attractive tool for quarantine inspection which helps in regulating ornamental fish trade. He has devised DNA barcoding sequence for cyprinid ornamental fish, an important group in terms of biosecurity risks. Kessler (2013) in her report has highlighted the new methods of cleaning up global aquarium trade. The report says about developing a test for cyanide exposure in fishing with poison. Though cyanide fishing is illegal in most countries, it remains prevalent in about 15 nations that supply the aquarium business, as well as the much bigger trade in live reef fish for Asian food markets, according to a 2012 report by Defenders of Wildlife. Movement of live aquatic animals within and between countries for aquatic animal protein and ornamental trade is an important path for the transfer and spread of diseases. Tlusty *et al.* (2013) have opined how public aquariums can behave as an efficient means of

enhancing sustainability in the ornamental fish trade. Less waste, protection of intact functioning ecosystems and maintaining the economic and educational benefits and impacts of ornamental fish trade can be forwarded through public aquariums thereby promoting aquatic conservation in a broad sense. Tlusty *et al.* (2013) stress on the role of public aquariums to advance the aquatic conservation. The study opines that since aquariums overlap with the pet trade, it gives aquariums significant opportunity to increase the sustainability of the trade in aquarium fishes and invertebrates.

Leadbitter *et al.* (2006) emphasizes on the roles that can be played by private sector in helping the government in maintaining the sustainability of fishery resources. The results of the study are based on Marine Stewardship Council (MSC) certification scheme. MSC certification has resulted in demonstrable improvements to fisheries management with the agreement of all interested parties. Due to the transport of seafood products across many boundaries, the certification and eco-labelling approach facilitates both co-operations across these boundaries and the adoption of best practices. MAC guidelines cover all stages of the chain of custody starting from collection to until it reaches the retailers. This will ensure that the economic benefit of the system obtained

by the better quality of fish will be distributed from consumers and retailers to collectors (NOAA, 2011). Dykman (2012) has explored the ways in which Marine Aquarium Council (MAC) promotes sustainability of marine ornamental fish and coral reefs. The study also discusses about social, environmental and economic ramifications for the poorer exporting countries caused by the economic disparity between importing and exporting countries. The study also proves the economic benefits of the MAC system using case studies. Edwards and Laurance (2012) highlights certain critical areas that are needed for the long-term protection of biodiversity through certification. These areas are the application of HCV to sustainable agricultural development at the national-level, the use of abandoned agriculture, the creation of Bio banks, and increased price premiums for certified products could redound to the long-term protection of tropical biodiversity.

1.7.2 Certification and ornamental fish industry

The studies of Lenzen *et al.* (2012) argue that 30% of the global species threat is due to international trade. Section 1.1.2 also deals with some of the unsustainable impacts of

ornamental fish trade. The prosperity of ornamental fish trade has led to emergence of issues like quality, environmental concerns, habitat protection and sustainability of the resources and led to the need for them being addressed quickly. Honey *et al.* (2001) addresses the issue of sustainability as the prior interest in the certification programs.

Muldoon and Scott (2005) has highlighted on the standards formed by the multi-stakeholder engagement process of the live reef food fish trade (LRFFT). The study opines that considering the current threats to the global reef system, collaborative resource management and a certification program to implement these standards would be an important step in managing the global reef system. Importance of specific certification and standards pops up when we look into many studies that prove that national legislation system in accordance with international regulations are not strong enough to regulate and manage the trade. One such study is that of Sampaio and Ostrensky (2013) in which the authors have examined the failure of Brazilian MOF legislation in fulfilling its function as an instrument for the conservation of MOF stocks.There are nearly 20 independent certification schemes for wild caught and capture based fish (Ward and Phillips, 2008). In India,

Marine Products Export Development Authority (MPEDA), Kochi, India has come up with certification requirements as an effort to cover up the sustainability issues posed by the industry (Silas *et al.*, 2011). As far as freshwater ornamental fish trade is concerned currently there are only few management initiatives like Green fish tracking for cardinal Tetra, Sustainable ornamental fish initiative of New England Aquarium, Legality of genetically modified organisms, Dragon fish farm registration scheme and Qian Hu Corporation Limited, Singapore (Ramachandran, 2010). Ramachandran (2012) has given a vivid picture about Green certification, the first of its kind freshwater aquarium fish certification program. The author highlights the significance of Green certification by pinpointing the fact that there is no body or process equivalent to Marine Aquarium Council (MAC), a certification program for marine ornamental fish. Shuman *et al.* (2004) points out how economic benefits achieved through certification has the potential to reduce the incentive for overexploitation and use of destructive fishing practices. Cohen *et al.* (2013) have mentioned in their study about the various traceability methodologies in the marine ornamental fish industry which is necessary to maintain sustainability in the trade. Certification and ecolabeling has been identified as one of the traceability

method. The study recommends the use of bacterial finger prints as the most suited method to trace marine ornamental fish species.

Harriott (2003) highlights the importance of Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) agreement in regulating the international aquarium trade. But at the same time also stresses on the problems of implementing these agreements in some developing countries because of limited natural-resource management capacity. Tissot *et al.* (2010) mentions in their study about how US being the largest importer of the marine ornamental fish species can strengthen US trade laws and enforcement capabilities combined with increasing consumer and industry demand for responsible.

1.7.3 Impact of ecolabels and certification on fisheries

Studies on impact of certification on forestry can be considered as a breakthrough that had enabled certification in fishery. One such study is that of Fischer *et al.* (2005) where the emergence of forest certification standards, current certification schemes, and the role of major corporations in creating demand for certified products has been discussed.

The study also pinpoints into the limited success of certification and some of the obstacles to its adoption in developing countries. By examining two leading certification systems – the Forest Stewardship Council and the Fair Trade Certified system – and emerging systems in tourism and mining, the study by Conroy (2005) explores whether certification systems can assist poor people, either individually or in community-based and small-to-medium production units, to build their natural assets as a basis for sustainable livelihoods. The results were mixed with greater poverty reduction in agriculture commodity trade.

Constance and Bonanno (2000) have analysed the societal regulations in the post-Fordist era. The analysis uses the case of the emergence of the MSC to investigate propositions regarding the existence of, and location of, nascent forms of a transnational State. The study indicates that the case of the MSC provides valuable insights into the possible characteristics of supranational regulatory mechanisms that might emulate the role of the nation-state in the post-Fordist era. Hoel (2004) has tried to evaluate the effectiveness of MSC program through the use of five indicators which are inclusiveness, strength of conservation standards, and quality of auditing, supply side participation,

and market penetration. A high score on such indicators was taken to be a sign of successful certification. Peacey (2000) elaborates on the MSC program, its standards and its way of certifying fisheries. Argued as being successful in the initial years, the work recommends certain factors for the future success of the MSC. These factors are MSC's ability to address challenges including, winning and maintaining the confidence of all stakeholders, building public awareness of the MSC Logo, ensuring the MSC Standard is relevant to all commercial capture fisheries and stay on the right side of international trade rules. Christian *et al.* (2013) argues in their work that the MSC's principles for sustainable fishing are too lenient and discretionary, and allow for overly generous interpretation by third-party certifiers and adjudicators, which means that the MSC label may be misleading to both consumers and conservation funders.

Potts and Haward (2007) also studied the emerging importance of certification and eco-labelling in the fisheries sector, the development and operation of the MSC, identifying particularly the role of 'third party certification' as promoted by the MSC, and also notes the opportunities and challenges for the MSC and eco-labelling in general. Bear and Eden (2008), while examining the multiple spatiality's of MSC's have argued that attention to a

multiplicity of spatialities helps direct attention to the role of non-humans in the acting out of hybrid geographies. Ponte (2008) has tried to find out the political economy of the fish ecolabeling and its local manifestation in South Africa. The study has concluded that the fisheries in developing country, in particular the small scale ones have been marginalized. Ecolabeling is sought in the context of competitive pressures and specific political economies, not simply on the basis of value-free science and systemic management. The study also argues that developing country producers need dedicated systems of standards and verification procedures not only special flexibilities. Gulbrandsen (2009) has examined the effectiveness of MSC certification program. The study concludes that fisheries certification alone is unlikely to arrest the decline of fish stocks, and highlights the need for more research on the intersection of private and public efforts to address overfishing and environmental harm resulting from fishing. Ramirez *et al.* (2012 a) opines that MSC certification is positively perceived because stakeholders focus on knowledge of the process. Most respondents consider certification as encouraging effective fishery stakeholders' participation: access to information, increased communication, and reaching consensus. Ramirez *et al.* (2012 c) discusses the future of the Marine Stewardship

Council (MSC) and opines that MSC needs to attract the interest of more fishing enterprises from these regions to increase its global presence. As most fisheries in developing countries cannot meet the MSC standards, or afford the certification process costs, it is suggested by the authors that there is a need for developing different levels within the MSC system and additional third-party assessing organizations.The content of the study by Bush *et al.* (2013) has also the same opinion that though MSC has gained credibility, it has risked its credibility by the poor representation from the developing countries. Also the authors define the situation of maintaining credibility, increasing access and improving fisheries as "Devil's Triangle". Goyert *et al.* (2010) has evaluated the significance of certified Maine lobster fishery. Though the work says that certified lobster fishery can induce a differentiation to the fishery and can also help to gain access to markets solely looking for certified fishery, the possibility of gaining extra price premiums is doubtful. The authors have opined that certification programs may need to adapt to consumer preferences and market conditions if they are to continue to provide incentives for the sustainable management of fisheries. The argument that co-management and community-based decision-making addresses the issue of fish sustainability is highlighted in the work by Ramirez

(2012 b). The work highlights the certification of red-rock lobster fishery of Mexico which is the first community based fishery to be certified. MSC certification leads to non-economic benefits, especially empowerment and community strengthening. It also had a positive impact on fishermen's cooperatives and gained international recognition for the Mexican fishery policy, with the possibility of increased renewal of fishermen's access rights.

Vandergeest and Unno (2012) opine that third party eco-certification by transnational organizations like the Forest StewardshipCouncil, Marine Stewardship Council, and the Aquaculture Stewardship Council as a new form of extraterritoriality in relation to the territorial sovereignty of states. Riisgaard (2009) in his article examines the opportunities and challenges that private social standards pose for labor organizations. It explores different labor responses to private social standards and reveals how retailer-driven chains offer more room for labor organizations to exercise their agency than the traditional value chains. Labor organizations have been able to influence social standard setting and implementation, and to use standards to further labor representation at production sites. Ponte (2008) highlights how the reluctance of the developing country governments and industries to support ecolabels, fearing their

potentially protectionist effects, has been countered by international organizations (such as FAO) and ecolabel initiatives with assurances of transparency, non-discrimination, and technical assistance.

1.7.4 Consumer preference of certified products with special reference to fisheries

There are many relevant studies highlighting the potential trade implications and effectiveness of ecolabeling (Norden, 2000; Gardiner and Viswanathan, 2004; European Environment Agency, 2005; FAO, 2005; FAO, 2006; EU, 2007; FAO, 2008; NE (Nordic Swan), 2008; Ward and Phillips, 2008; Washington, 2008; FAO, 2009a; FAO, 2009b; FAO, 2010; Parkes *et al.*, 2010; Sainsbury, 2010; FAO,2011; NAAS, 2011; OECD, 2011; Potts *et al.*, 2011; Silas *et al.*, 2011; Washington and Ababouch, 2011; Big Room Inc., 2012; FAO, 2012 and NACA, 2012).Consumer knowledge of sustainability and corporate social responsibility is increasing in renewable resource industries, which can be taken as a sign indicating that this is the appropriate time for the ornamental fish trade to adopt a sustainability platform (Tlusty *et al.*, 2013). Aschehoug and Boks (2013) introduce

a definition of sustainability information relevant to product development and synthesises existing literature from the period 2000–2010 with the purpose of identifying, collecting and compiling relevant sustainability information into a framework. The study opines that important, accessible and accurate sustainability information (SI) beyond product and process data is a prerequisite for making knowledge-based decisions in product development and for reducing the unsustainable impacts of products. Yue and Tong (2009) has investigated the Willingness -to –Pay (WTP) for organically grown and locally grown fresh produce and the marketing segmentation of these two types of produce. The results suggest that when real products were used in the hypothetical experiment, the hypothetical bias (the difference between what people say they will pay and what they would actually pay) was not high. Consumers' socio-demographics affected their choice between organically grown and locally grown produce. The consumers patronized different retail venues to purchase fresh produce with different attributes. Husted *et al.* (2013) has challenged the theoretical assumption that the relationship between environmental attitudes and purchasing is linear. The paper explores how environmental attitudes of consumers in Mexico influence their willingness to pay a premium for environmentally-certified products. The

study has concluded that as attitudes become more pro-environmental, they more than proportionally boost marginal WTP. Barham (2012) concludes in his study that yields rather than price premiums are most important for increasing net cash returns. The findings suggest that certification norms that permit improving yields are essential for improving grower welfare and attracting and maintaining growers. Eltayeb *et al*. (2011) has attempted for a conclusive study on the relationship between green supply chain initiatives and performance outcomes. The results of the study show that eco-design had a positive impact on the four types of outcomes which are environmental outcomes, economic outcomes, cost reductions, and intangible outcomes. But green purchasing was not found to have significant effect on any of the four types of outcome. Ventura- Lucas (2004) studied the impact of food safety related issues on consumer behaviour. The study has intruded into the consumers' level of concern about food crises, their view on the safety of several products throughout the supply chain and the assessment of different practices to reduce food poisoning risks. The role of labels and the different information channels on purchasing habits have also been studied. The results indicate that, the factors measuring lifestyle, especially those related to safety, and mainly, consumption experience, seem

to be the main aspects explaining Portuguese consumers' perception on food safety. With regard to reading of labels, the date of caducity is the information more consulted by the consumers, leaving of part other important food safety and health imformations like instructions of storage and cooking and nutritional. O'Brien and Teisl (2004) have found that consumers are willing to pay for certified products but changes in labeling policy affects their willingness to pay. Thus, there appears to be a demand for environmentally certified forest products, however, the current use of ecoseal may preclude the collection of an actual premium. Delmas and Lessem (2011) have compared two similar eco-labels for wine to analyse the effect of information asymmetry of these labels. Through discrete choice experiment it was found that focusing purely on information asymmetries will not necessarily create eco-labels that align eco-products with the needs of consumers. The technique of discrete choice analysis has been used in many studies to construct a product demand model like Wassenaar and Chen (2001), Ida and Kuroda (2006). Earnhart (2002) has also used discrete choice analysis to understand the factors influencing the housing decisions. A study done to find the consumer demand for eco-labelled apples, conducted by Blend and Ravenswaay (1999), has found that demand for ecolabeled apples decreased with

increased price premiums for labelled apples. Comprehensiveness of environmental claims and the amount of proof were also not found to affect purchase probability or the quantity purchased. Selfa *et al.* (2008) addresses intersection between producer and consumer attitudes toward environmental sustainability with their actual practices in Washington State, USA. The study has found out that consumers' and producers' practices are not always consistently correlated with their environmental attitudes, but that support for agricultural land preservation is one policy area in which the interests of producers and consumers intersect with their interest in sustainable farming and food.

Brécard *et al.* (2009) discuss the theoretical motivations of the consumption of eco-friendly products and the factors influencing the European perceptions regarding the fact that "fish caught using an environmentally friendly technique may carry a special label". Their results show that there is significant connection between the desire for eco-labeling and seafood features, especially the freshness of the fish, the geographical origin of the fish and the wild versus farmed origin of the fish. Olesen *et al.* (2010), in their study to elicit the consumers' willingness to pay for organic and welfare-labelled salmon, opine that consumers are willing to pay to improve animal welfare and reduce undesirable

environmental effects from fish farming. It was also shown that the producers of alternatively labelled seafood products must consider the aesthetic properties of their products and that labelled products of inferior appearance are unlikely to achieve the necessary price premium. Geographical indications are understood by consumers to denote the origin and the quality of products. False use of geo-graphical indications by unauthorised parties is detrimental to consumers and legitimate producers. The former are deceived and led into believing to buy a genuine product with specific qualities and characteristics, while they in fact get a worthless imitation (WIPO, 2002).

Geographical Indications (GI) define who can make a particular product, where the product is to be made, and what ingredients and techniques are to be used so as to ensure 'authenticity' and 'origin'. Hence from an economic standpoint GI's are seen as a form of collective monopoly right that erects entry barriers on producers either within or outside the relevant geographical area (Rangnekar, 2004).

Certification marks are marks which indicate the goods or services on which they are used have specific qualities and maybe, though not necessarily, of certain geographical origin. As a general rule the owner of a certification mark does not 'use' the mark but licenses it to other enterprises

and certifies that the goods or services carrying the mark are of a certain quality. (Vivas and Muller, 2001). The differences between GIs and certification marks have a wider importance in terms of the options for implementing obligations under the Trade Related Aspects of Intellectual Property Rights (TRIPs) Agreement (Correa, 2002).

OECD (2000) gives an elaborate discussion about the differences between certification and GI. When GI is the protection of the identification of product's origin and its link with quality and reputation, while certification protects the quality characteristics of products, which may – though not necessarily – include geographical origin. But registration under GI can also act as a certification that the product possesses certain reputation corresponding to the place of origin, which can increase the credibility of the quality of the product.

CHAPTER 2

RESEARCH METHODOLOGY

2.1 Research Methodology

The following is a pictorial representation of the research methodology of the study. The study was divided into four broad objectives for easy accomplishment of the work. Fig 1 shows the pictorial representation of how work had progressed.

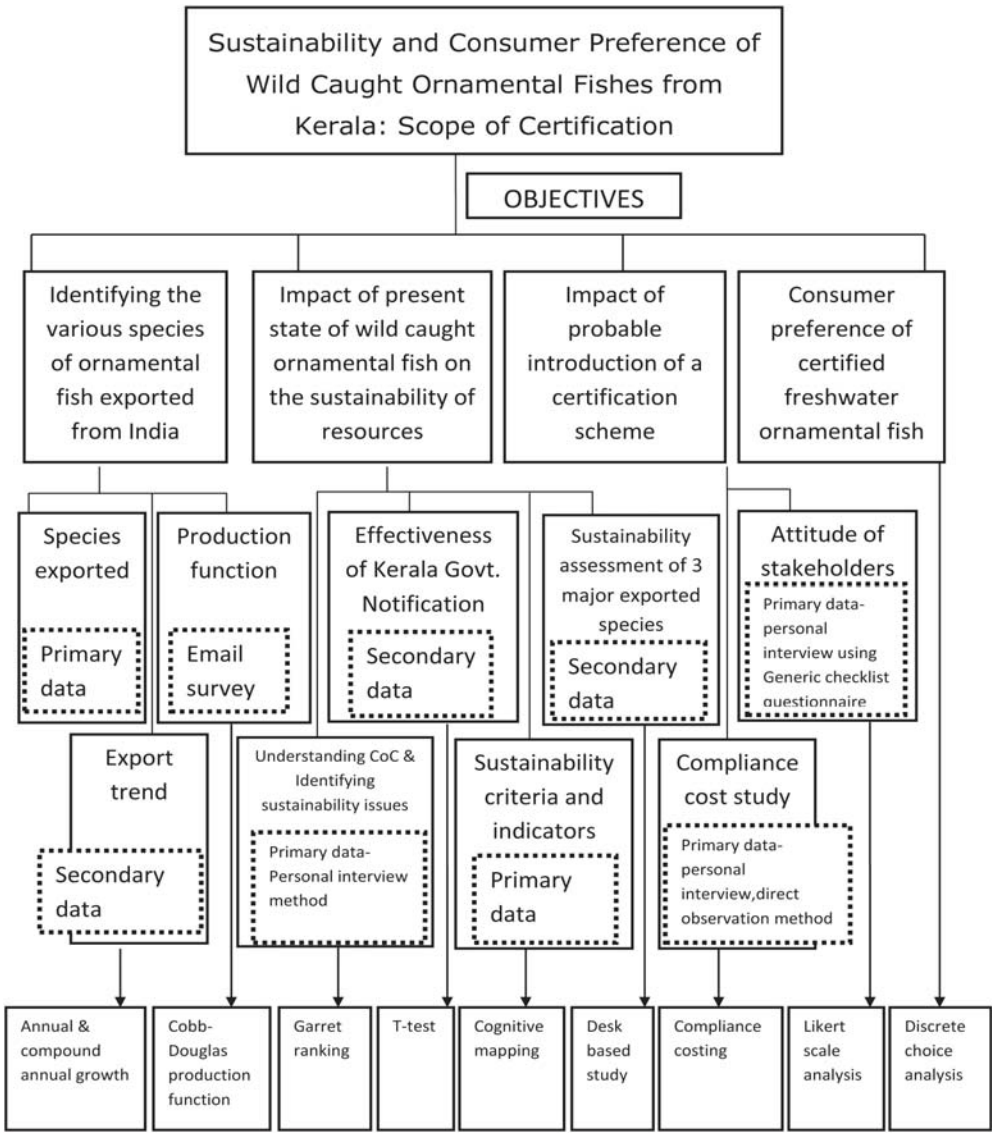

Fig 1: Pictorial representation of the outline of the study

2.2 Research Design

Research design deals with stating the conceptual structure within which research would be conducted. It depends on the research objective. The study on "Sustainability and Consumer Preference of Wild Caught Ornamental Fishes from Kerala: Scope of Certification" takes up an exploratory research purpose. As the purpose is exploratory, the research design is flexible which provides opportunity for considering many different aspects of a problem.

The work mainly proceeds on two main aspects:

- Finding the probable impact of certification on the sustainabilty of wild caught ornamental fish
- Finding the consumer preference for certifed fresh water ornamental fish

The first part of the work highlights the ornamental fish exported from India and the export trends of the ornamental fish industry. The work has also tried to consolidate the chain of custody and the sustainability criteria and indicators for wild caught ornamental fish. The work has also done the sustainability assessment of three major exported indigenous ornamental fish and discussed the flaws of a government notification enacted to conserve *Puntius denisonii*. The impact of certification was done mainly on

two notions- a compliance cost study to see the impact of cost of complying with the certification and also a predictive attitude scaling of stakeholders towards adopting certification. Annual and compounded annual growth, Cobb Douglas production function (Douglas, 1948), Garret ranking (Garret and Woodworth, 1966), Cognitive mapping (Eden and Akermann, 1998), compliance costing (Aloui and Kenny , 2005) and Likert scale (Weiers, 1984) measurement comprise the main methods for analyses during the first part of the work.

The second part of the work has tried to predict the consumer preference for certified freshwater ornamental fish. The study selected a group of hobbyists from a forum. Discrete choice analysis (Alencastro, 2004) was used to analyse the results.

2.3 Data Collection

Primary data and secondary data were gathered to accomplish the work. Primary data on investment details was collected from exporters, fish species exported, tracking the chain of custody of wild caught ornamental fish, finding the sustainability issues along the chain of custody, predictive attitude of stakeholders regarding the impact of certification

on the sustainability of fish resources and also the consumer preference of certified fish. Both primary data and non-participant observation method (Liu and Maitlis, 2010) was used for the compliance cost study. The details regarding the ornamental fish species exported were also procured from Marine Products Export Development Authority (MPEDA), Kochi, India. The raw data of the species exported were obtained from the invoices, which were compiled by the author for analysis and interpretation. Besides primary data, secondary data was used for the sustainability assessment of the three major exported fish species. Secondary data was also procured from sources like peer reviewed scientific articles, books, reports, proceedings, websites and also from government institutes like Marine Products Export Development Authority, Kochi, India and Central Marine Fisheries Research Institute, Kochi, India.

2.4 Survey Method and Instrument

The direct personal interview method, Email survey and non-participant observation method was used to acquire primary data for the first part of the study. Two structured questionnaires were developed for the first part of the work.

First questionnaire contained queries regarding the investment details of the stakeholders and second questionnaire concentrated on the stages and sustainability issues of chain of custody. The second questionnaire also included a generic questionnaire checklist to mark the attitudes of the stakeholders towards certification.

The second part of the study was accomplished using E-mail survey method. A structured questionnaire was prepared and sent via email to hobbyists in a forum. The questionnaire included questions on respondent characteristics and different choice sets of fish (See Annexure for questionnaire).

2.5 Sample Selection

In the present study three surveys were carried out. The first survey which was carried out in India, was targeted on ornamental fish exporters. The Indian exporters were surveyed to get an idea about the various species that were exported from India and also to get details about their investment. Out of 59 registered exporters under MPEDA, at the time when survey was carried out, only 35 were active in the exports (2009-2010). Many of the email-id's that were provided were not active. Out of 35 active exporters, a census

survey (Aaker *et al*., 2001) was carried out to include all the exporters. Only 25 exporters responded positively to the survey and agreed to give details regarding the species they were exporting. For the period 2009-2011 exporters provided the details of the species exported. Data on species exported during the period 2006-2008 was compiled from the invoices of the exporters. For the details regarding investment, to analyse production function, 25 exporters gave their details of investment for a year.

The second survey which was carried out in Kerala was targeted mainly on ornamental fish collectors and exporters and also included other stakeholders in the chain of custody of export of wild caught ornamental fish from Kerala. The survey was mainly aimed to find the chain of custody of the wild caught ornamental fish exported, for the compliance study and also for the attitude measurement of stakeholders towards certification. Though there are no official records of number of ornamental fish collectors in Kerala, it's been known from the preliminary survey that there are hardly 15- 20 fish collectors involved currently. Out of them 10 fish collectors were randomly selected for the study. During the survey period 2011-2012, from the MPEDA exporter's directory, there were 16 registered ornamental fish exporters from Kerala. Out of them only 11

were involved in the fresh water wild caught ornamental fish export. Census survey method (Aaker *et al.*, 2001) was followed for surveying the exporters. But of these 11 exporters, only 10 were ready to co-operate with the survey.

The third survey was carried out by developing internet based questionnaire (Dillman, 2000) using the survey instrument kwiksurveys.org. The sample frame consisted of aquarium hobbyists identified from an aquarium fish hobbyist's forum aquaticquotient.com. Since it was difficult to identify each consumer and also due to the constraint of getting the response, convenience sampling techniques were used (Schiffmann and Kanuk, 2001). Convenient samples of 117 respondents were taken out of which only 100 completely filled surveys were present. The data collection was implemented by sending the questionnaires to the hobbyists via e-mail (Malhotra, 2001).

2.6 Data Analysis

Data, which comprised both primary and secondary data, was analysed using different techniques.

2.6.1 Software used

Data was primarily analysed using software SPSS-20. SPSS 20 was used for multinomial regression and production function. Software Decision explorer was used for creating cognitive maps for linking sustainability indicators and criteria.

2.6.2 Analysis

Production function

Production function defines the relationship between inputs and the maximum amount that can be produced within a given period of time with a given level of technology, cross sectional analysis

Q=f(X1, X2... Xk), where

Q= level of output

X1, X2,…..Xk = inputs used in production.

For the study Cobb- Douglas production function method was used which was estimated using linear regression in Excel 2007 following Sah (2009). One of the advantages of production function is that it can accommodate any number of independent variables and does not require any constant technology (Fernando and Quijano, 2009).

Annual and Compound annual growth

Annual growth and compound annual growth were computed to assess the growth of the ornamental export industry.

Annual growth rate= (this year-last year)/last year

Compound annual growth rate=

((last year/first year) ^ (1/n-1))-1

Where, n=number of years

Garret ranking

The ranks were analysed using Garrets Ranking Technique (Garret &Woodworth, 1966).

Garrets formula

$$\text{Percent position} = \frac{100\,(R_{ij} - 0.5)}{N_j}$$

Where,

R_{ij} represents the rank given to i^{th} variable by j^{th} respondent

N_j represents number of variables ranked by j^{th} respondent

Cognitive mapping

Cognitive mapping (Eden and Akermann, 1998) was used to find the interactions between the criteria and the indicators. The method is well suited for complex problems

where many aspects and dimensions of the problems are difficult to comprehend adequately (Mendoza and Prabhu, 2002). Two primary analytical constructs based on cognitive mapping were used. They are domain and centrality.

Domain indicates the 'density' or number of indicators directly linked to a particular indicator regardless of direction. Thus higher domain values reflect a larger number of indicators directly affecting or affected by the indicator. Centrality reflects downstream effect combining both direct and indirect effects which in turn reflect the strategic significance indicating the cumulative impact of an indicator beyond the direct impact.

Centrality was identified after finding the central score which is defined as

$$C_i = S_j / j + \ldots\ldots\ldots\ldots + S_n / n$$

Where,

j = 1, 2,…….n

i = indicator

C_i = central score of indicator 'i 'considering 'j' levels of interactions (Eden and Akermann, 1998).

The central scores of three levels were found using Decision explorer.

Compliance cost analysis

The costing was executed using Excel 2010.

Likert scale analysis

Likert scale is one of the most widely used attitude scaling techniques. The respondent is asked to indicate his degree of agreement or disagreement with each series of statements. Individual scores are achieved by totalling the item scores of each statement. Each individual's response to unfavourable statements is multiplied by -1. The scores are then compared with the maximum possible score and the minimum possible score. Based on this comparison, it would infer whether the individual has positive attitude or negative attitude to each statement (Chisnall, 1973 and Weiers, 1984).

Discrete choice analysis

The technique allows the analysis of the market potential for the product or service prior to its introduction (Bennet *et al.,* 2001). Two discrete choice experiments were conducted to analyse the importance of product attributes based on consumer's decision on which product to buy. The experiments involved *Puntius denisonii* (Red line Torepedo Barb) and *Tetraodon travancoricus* (Dwarf Puffer). *Puntius denisonii* is a much sought after indigenous ornamental fish

exported from India and is categorized as Endangered according to IUCN (2012). *Tetraodon travancoricus* is the most exported indigenous ornamental fish species from India (Personal Communication, MPEDA,) and is categorized as Vulnerable according to IUCN (2011). These species were also selected because they were found to be popular with the aquarium hobbyists. Both the experiments were used to study the interaction of respondent characteristics with the interactive effect of price of the fish and whether they are certified or not.The results were further analysed using the multinomial logistic regression method (Chan, 2005 and Mala *et al*., 2010) and analysed using SPSS 20.

CHAPTER 3

EXPORT TREND OF INDIAN ORNAMENTAL FISH INDUSTRY

3.1 Introduction

Aquarium fish keeping as a hobby has a long history dating back to many centuries. Introduction of civil aviation after the Second World War expanded the hobby to a global industry (Tissera, 2010). The equatorial belt of South-East Asia is a potential conglomerate of landmasses for ornamental fish trade. The region is rich with exceptionally diverse fish species (Ng and Tan, 1998). Singapore enjoys 46% of the market share, Israel 17%, Indonesia 12%, Japan 10% followed

by Thailand, Srilanka and USA with a share of 5% each (Tissera, 2012). Marine ornamental fish trade estimated more than 11 million fish imported from 40 countries to US, which was less than previously reported (Anon, 2012). The global trade in freshwater fish is a large and diverse industry, estimated to be worth around USD15–30 billion a year. Supplied by captive-bred and wild-caught specimens, the aquarium trade is dependent on the replenishment capabilities of wild freshwater fish populations and sustainable methods of capture (IUCN, 2013 a).

India is one of the 12 mega diversity countries of the world and is blessed with vast and varied resources rich with a vivid ecological heritage and biodiversity. Adding more to the rich biodiversity is the contribution from two biodiversity hotspots, The Western Ghats and The North Eastern region of India, which belong to the twelve global biodiversity hotspots of the world. The Western Ghats zone hold large populations of most of the vertebrate species found in peninsular India, plus an endemic faunal element of its own and the North-East is the bio-geographical 'gateway' for much of India's fauna and flora (Mathur and Rajvanshi, 2001). In 2010-2011, India exported ornamental fish worth 1.26 million USD (Nair, 2012) which is a discouraging figure

as far as the rich piscine diversity of India is concerned. Out of 274 freshwater fish species from North Eastern States only 32% of native fish are exported (Mahapatra *et al.,* 2007) and among 287 freshwater species from Western Ghats (Shaji *et al.*, 2000), only 114 species are exported (Anon, 2005).

Exporting per se is widely concerned to be good for economic growth (Naude *et al.*,2010). Foster (2006) has mentioned that the benefits of exports come from knowledge spillovers and knowledge diffusion; greater the scope for economies of scale; greater the competition and efficiency; and the loosening of a country's foreign exchange constraint. Developing countries should export goods that have good demand as it is this compatibility with the world demand that will determine the extent to which a country's exports will grow (Alexander and Warwick, 2007). Export variety which is a measure of product variety is positively correlated to the relative per capita income (Funke and Ruhwedel, 2005). In ornamental fish trade the need is for large number of species or varieties in large quantities (Sane, 2007). Non-uniqueness and limited specimens discouraged the Japanese importers to have trade with India initially (Kawada, 2007). This condition has changed with the introduction of

Tetraodon travancoricus, Scarlet badis and Drape fin barbs as reported by the same author. Production function can be used to investigate the association between the growth of exports and economic performance (Vohra, 2001). One of the biggest advantages of using Cobb- Douglas production function is its simplicity and also its easy to make senses out of the coefficients imposed (Tan, 2008).

With this perspective the objective of the study was

1 To list the various ornamental fish species exported from India so as to know the product variety.

2 To provide an overview of the trends in the Indian ornamental fish export industry.

3 To develop the production function model for the ornamental fish exporting firms in India.

3.2 METHODOLOGY

3.2.1 Listing fish species and estimating export trend

The method for data collection consisted of information gathering from various ornamental fish

exporters in India using an e-mail survey (Malhotra, 2001). From about 59 registered exporters only 25 were ready to co-operate with the survey. Besides the survey, various documents such as databases, reports, manuscripts, research papers and articles were also used to collect information. Information from the unpublished export invoices collected from Marine Products Export Development Authority (MPEDA), Kochi, India was compiled to get data regarding fish species exported. Secondary data was also collected from Ministry of Commerce, Government of India. The export data obtained from Ministry of Commerce, Government of India, were used to compute the annual growth and compound annual growth (Siegel *et al.*, 1997) as mentioned in Section 2.6.2.

3.2.2. Estimating production function

A structured questionnaire was used to survey the exporters using Personal Interview Method (Churchill, 1995), e-mail method (Malhotra, 2001) and Non-participatory Observation Method (Liu and Maitlis, 2010).The survey included questions on the capital

investment, labour wages, quantity exported and other miscellaneous expenses. The sample unit consisted of 25 exporters. Out of 59 exporters in the MPEDA directory only 35 were actively involved in the export trade. Cobb- Douglas production function (Douglas, 1948) was used. The equation that was used

$Q= A.K^a.L^b.M^c$

where,

Q= Quantity of fish exported

K= Capital investment

L= Labour

M= other expenses

A,a,b,c = parameters

Multiple regression analysis was carried out for the further analysis and the analysis was executed using Excel 2007.

3.3 RESULTS AND DISCUSSION

3.3.1 Listing fish species and estimating export trend

287 indigenous ornamental fish species, 92 exotic ornamental fish species and 45 ornamental shrimps were exported from India. Among the 287 indigenous species, 239 were freshwater fish and 48 were marine. Among the indigenous freshwater species the largest number of species belonged to the family Cyprinidae. Ninety eight species belonged to Cyprinidae, 16 species each belonged to families Bagridae and Balitoridae and 12 species belonged to families Channidae, Cobitidae and Sisoridae. The number of species exported has increased since the study by Sekharan (2006).

Table1: Native Freshwater Fish Species found to be exported

** new species added after list by Sekharan (2006)*

FAMILY	NATIVE SPECIES (FRESHWATER)
Adrianichthyidae	*Oryzias dancena**
Ambassidae	*Chanda nama**
	Chanda ranga
	*Chandathomassi**
	Chanda wolffii
	*Parambassis lala**
	*Parambassis ranga**
	Parambassis thomassi
Amblycipitidae	*Amblyceps mangois*
Anabantidae	*Anabas cobojius**
	Anabas testudineus
Anguillidae	*Anguilla bengalensis*
Aplocheilidae	*Aplocheilus blockii*
	Aplocheilus lineatus
	Aplocheilus panchax
	*Aplocheilu sparvus**
Badidae	*Badis badis*
	Badis badis assamensis
	*Badis blosyrus**
	*Badis kanabos**
	Dario dario
Bagridae	*Batasio batasio*
	*Batasio fasciolatus**
	*Hemibagrus menoda**
	*Hemibagrus punctatus**
	Horabagrus brachysoma

	Horabagrus nigricollaris
	*Mystus bleekeri**
	*Mystus carico**
	Mystus gulio
	Mystus tengara
	Mystus vittatus
	Rama chandramara
	Rita gogra
	Rita rita
	Sperata aor
	Sperata seenghala
Balitoridae	*Aborichthys elongates**
	*Aborichthys tikaderi**
	Acanthocobitis botia
	Acanthocobitis rubidipinnis
	*Mesonemacheilus guentheri**
	Mesonoemacheilus triangularis
	Nemacheilichthys rupelli
	Schistura barapaniensis
	Schistura beavani
	Schistura corica
	Schistura denisonii dayi
	*Schistura rupecola**
	*Schistura savona**
	Schistura scaturigina
	*Schistura tigrinum**
	*Schistura vinciguerrae**

Belonidae	*Xenentodon cancila*
Chacidae	*Chaca chaca*
Channidae	*Channa amphibious*
	*Channa aurantimaculata**
	Channa barca
	Channa bleheri
	*Channa diplogramma**
	Channa gachua
	Channa harcourtbutleri
	Channa marulius issabella
	Channa punctata
	Channa stewarti
	Channa striata
Chaudhuriidae	*Pillaia indica**
Cichlidae	*Etroplus canarensis*
	Etroplus maculates
	Etroplus suratensis
Cobitidae	*Botia almorhae**
	Botia Dario
	Botia lohachata
	Botia rostrata
	Botia striata
	Lepidocephalichthys gunthea
	*Lepidocephalichthys menoni**
	Lepidocephalus annandalei
	Lepidocephalus goalparensis

	Lepidocephalus thermalis
	Pangio pangia
	Somileptes gongota
Cyprinidae	*Barilius bakeri*
	*Barilius barila**
	Barilius barna
	*Barilius bendalensis**
	Barilius canarensis
	*Barilius dogarsinghi**
	*Barilius evezardi**
	*Barilius radiolatus **
	Barilius shacra
	Barilius tileo
	Barilius vagra
	*Catla catla**
	*Chagunius chagunio**
	Chela cachius
	*Cirrhinus fulungee**
	*Cirrhinus mrigala**
	Crossocheilus latius latius
	Danio dangila
	Danio rerio
	*Devario acuticephala**
	Devario aequipinnatus
	*Devario assamensis**
	Devario devario
	*Devario malabaricus**

	*Esomus barbatus**
	Esomus danricus
	Garra annandalei
	Garra bicornuta
	Garra gotyla
	Garra hughi
	*Garra kempi**
	*Garra lampta**
	Garra lissorhynchus
	*Garra nasuta**
	*Gonoproktopterus curmuca**
	Horadandia atukorali
	*Hypselobarbus curmuca**
	*Hypselobarbus jerdoni**
	*Hypselobarbus lithopidos**
	*Labeo angra**
	*Labeo ariza**
	*Labeo bata**
	Labeo boga
	*Labeo boggut**
	*Labeo calbasu**
	*Labeo dero**
	*Labeo dyocheilus**
	*Labeo kontius**
	*Labeo nandina**
	*Labeo nigriscens**
	*Labeo rohita**

	Laubuca dadiburjori
	Laubuca laubuca
	*Neolissochilus hexagonolepis**
	*Neolissochilus wynaadensis **
	Oreichthys cosuatis
	*Osteobrama belangeri**
	Osteobrama cotio cotio
	Osteochilus nashii
	*Puntius arenatus**
	Puntius arulius
	Puntius arulius tambraparnie
	*Puntius assimilis 'Maskara'**
	*Puntius cauveriensis**
	Puntius chalakudiensis
	Puntius conchonius
	Puntius denisonii
	Puntius fasciatus
	Puntius filamentosus
	Puntius filamentosus lepidus
	Puntius gelius
	Puntius guganio
	Puntius jerdoni
	Puntius mahecola
	*Puntius manipurensis**
	*Puntius meingangbii**
	Puntius melanampyx
	*Puntius mudumalaiensis**

	Puntius narayani
	Puntius phutunio
	Puntius sahyadriensis
	*Puntius setnai**
	Puntius shalynius
	Puntius sophore
	*Puntius tambraparniei**
	Puntius terio
	Puntius ticto
	Puntius vittatus
	*Rajamas bola**
	Rasbora daniconius
	Rasbora rasbora
	*Rohtee ogilbi**
	*Salmophasia phulo**
	Tor khudree
	*Tor mosal**
	Tor musullah
	*Tor progeneius**
	*Tor putitora**
	*Tor tor**
Erethistidae	*Erethistes pusillus **
	*Erethistoides montana**
	Hara hara
	Hara horai
	Hara jerdoni
	Laguvia kapoori

	Laguvia ribeiroi
	Laguvia shawi
	*Pseudolaguvia muricata**
Gobiidae	*Brachygobius nunus*
	Glossogobius giurus
	Gobiopterus chuno
	Pseudapocryptes elongatus
	Stigmatogobius sadanundio
Heteropneustidae	*Heteropneustes fossilis*
Mastacembelidae	*Macrognathus aral*
	*Macrognathus pancalus**
	Mastacembalus armatus
Moringuidae	*Moringua raitaborua*
Mugilidae	*Rhino mugilcorsula*
Nandidae	*Nandus andrewi**
	Nandus nandus
	Pristolepis malabaricus
	Pristolepis marginata
Notopteridae	*Chitala chitala**
	Notopterus notopterus
Olyridae	*Olyra longicaudata*
Osphronemidae	*Ctenops nobilis*
	*Polyacanthus fasciatus**
	*Polyacanthuslalius**
	*Polyacanthus sota**
	Pseudosphromenus cupanus
	*Pseudosphromenus dayi**

Pangasiidae	*Pangasius pangasius*
Schilbeidae	*Neotropius atherinoides**
Siluridae	*Ompok bimaculatus*
	Ompok pabda
	Wallago attu
Sisoridae	*Bagarius bagarius*
	Bagarius yelleri
	*Exostoma labiatum**
	Gagata cenia
	*Gagata gagata**
	*Gagata sexualis**
	Glyptothorax cavia
	*Glyptothorax housei**
	*Glyptothorax lonah**
	*Glyptothorax telchitta **
	Gogangra viridescens
	Sisor rhabdophorus
Synbranchidae	*Monopterus albus**
	*Monopterus cuchia**
Syngnathidae	*Microphis deocata**
Tetraodontidae	*Carinotetraodon imitator**
	Carinotetraodon travancoricus
	Tetraodon cutcutia
	Tetraodon fluviatilis

** new species added after list by Sekharan(2006)*

Among the indigenous marine fish species, 13 belonged to the family Gobiidae, 4 species belonged to family Muraenidae and 3 species belonged to family Ariidae (Table 2).

Table2: Native marine fish species found to be exported

Family	**Native Species (Marine Water)**
Ariidae	*Arius dussumieri*
	*Arius sagor**
	Arius sona
Batrachoididae	*Allenbatrachus grunniens**
Blenniidae	*Istiblenniu sedentulus**
	*Omobranchus zebra**
Carangidae	*Gnathanodon speciosus**
Chaetodontidae	*Chaetodon collare**
Cynoglossidae	*Cynoglossus semifasciatus**
Eleotridae	*Eleotris fusca*
	*Ophiocara aporos**
Gobiidae	*Acentrogobius viridipunctatus**
	Apocryptes bato
	Boleophthalmus boddarti
	*Drombus globbiceps**
	Gobiopsis macrostoma
	Odontamblyopus rubicundus
	Oligolepis acutipennis
	*Oxyurichthys microlepis**
	*Periophthalmus dipus**
	Periophthalmus pearsei
	*Pseudapocryptes lanceolatus**
	Scartelaosh istophorus
	*Taenoides cirratus**

	Trypauchen vagina *
Hemiramphidae	*Hyporhamphu slimbatus**
Latidae	*Lates calcarifer*
Lutjanidae	*Lutjanus argentimaculatus**
Monodactylidae	*Monodactylus argenteus**
Muraenesocidae	*Congresox talabon 'hi-fin conger eel'**
	*Congresox talabonoides**
Muraenidae	*Gymnothorax sathete**
	*Gymnothorax tile**
	Lycodontis tile
	*Siderea thyrsoidea**
Ophichthidae	*Pisodonophis boro*
Ostraciidae	*Lactoria cornuta**
Platycephalidae	*Platycephalus bengalensis**
	*Platycephalus indicus**
Plotosidae	*Plotosus canius*
Ptereleotridae	*Parioglossus pillipinus**
Scatophagidae	*Scatophagus argus argus*
Sillaginidae	*Sillaginopsis panijus*
	*Sillago sihama**
Soleidae	*Euryglossa pan**
Sparidae	*Acanthopagrus berda**
Syngnathidae	*Syngnathus spicifer**
Tetraodontidae	*Chelondon patoca*

** new species added after list by Sekharan(2006)*

Among the exotic ornamental fish that were exported from India, 19 species belonged to the family Cyprinidae , 9 species belonged to the family Cichlidae and 5 species belonged to the family Osphronemidae (Table 3).

Table 3: Exotic fish species

Family	EXOTIC FISH SPECIES
Acanthuridae	*Zebrasoma veliferum*
Actiniidae	*Anthopleuraxantho grammica*
Ampullaridae	*Pomacea bridgesii*
Anostomidae	*Anostomus ternetzi*
Ariidae	*Hexanematichthys seemanni*
Atyidae	*Typhlaty ailiffei*
Auchenipteridae	*Ageneiosusmarmoratus*
Badidae	*Badis burmanicus*
Balitoridae	*Schistura macrocephalus*
Blenniidae	*Ecsenius axelrodi*
Callichthyidae	*Corydoras aeneus*
	Corydoras julii
	Corydoras paleatus
Centrarchidae	*Lepomis gibbosus*
Channidae	*Channa pulchra*
Characidae	*Gymnocorym busternetzi*
	Hemigrammus anisitsi
	Hyphessobrycon serape
Cichlidae	*Astronotus ocellatus*
	Cichlasoma severum
	Hemichromis paynei

	Herichthys cyanoguttatus
	Julidochromis
	Pseudotropheus greshakei
	Pseudotropheus zebra
	Pterophyllum scalare
	Thorichthys meeki
Claridae	*Clarias batrachus*
	Clarias macrocephalus
Cobitidae	*Botia kubotai*
	Chromobotia macracanthus
	Cobitis striata
Cyprinidae	*Barbus apleurogramma*
	Barbus quadripunctatus
	Brachydanio kerri
	Carassius auratus
	Crossocheilus siamensis
	Danionella translucida
	Epalzeorhychus frenatus
	Epalzeorhynchus bicolor
	Garra rufa
	Hypsibarbus wetmorei
	Labeochrysophekadion
	Laubuca caeruleostigmata
	Puntius lineatus
	Puntius nigrofasciatus
	Puntius orphoides
	Puntius semifasciolatus

	Puntius tetrazona
	Rasbora trilineata
	Tanichthys albonubes
Doraridae	*Platydoras costatus*
Eleotridae	*Eleotris marmorata*
Erethistidae	*Hara filamentosa*
Gnathophyllidae	*Hymenocera picta*
Gobiidae	*Brachygobius doriae*
	Gobiodon ceramensis
	Gobiosoma oceanops
	Gobius tigrellus
Haemulidae	*Plectorhinchus vittatus*
Helostomatidae	*Helostomatemminckii*
Loricariidae	*Hypostomus plecostomus*
	Rineloricaria fallax
Lutjanidae	*Lutjanu scampechanus*
Mastacembelidae	*Macrognathus siamensis*
Muraenidae	*Gymnothorax moringa*
Mysidae	*Praunus flexuosus*
Nothobranchiidae	*Epiplatys chevalieri*
Ocypodidae	*Uca perplexa*
Osphronemidae	*Betta splendens*
	Trichogaster leeri
	Trichogaster microlepis
	Trichogaster trichopterus
	Trichopodus trichopterus
Osteoglossidae	*Scleropages jardinii*

Pangasiidae	*Pangasius sutchi*
Parathelphusidae	*Austrothelphusa transversa*
Pimelodidae	*Leiarius pictus*
Poecilidae	*Poecilia latipinna*
	Poecilia sphenops
	Xiphophorus helleri
Pomacanthidae	*Centropyge aurantia*
Potamonidae	*Parathelphusa martens*
Pterelectridae	*Parioglossus palustris*
Rhynchocinetidae	*Rhynchocinetes rigens*
Scyliorhinidae	*Apristurusg ibbosus*
Sebastidae	*Helicolenus percoides*
Stichodactylidae	*Stichodactyla haddoni*
Stomidae	*Stomias boa boa*
Syngnathidae	*Ichthyocampus carce*
Tetraodontidae	*Takifugun iphobles*
	Tetraodon mbu

Table 4: Ornamental shrimps being exported

SHRIMPS
Caradina Sp./Zigzag Shrimp
Caradina tiwari
Caridina babaulti
Caridina gracileps
Caridina gracilirostris
Caridina hodgarti
Caridina new 'Black Beauty'
Caridina Sp./Black banded Green Shrimp
Caridina Sp./Black banded Shrimp
Caridina Sp./Black Shrimp
Caridina Sp./Dwarf Green Shrimp
Caridina Sp./Fire Head shrimp
Caridina Sp./Green Shrimp
Caridina Sp./Ivory Shrimp
Caridina Sp./Zebra Shrimp
Macrobrachium assamensis
Macrobrachium banjare
Macrobrachium duarii
Macrobrachium dulichodctileus
Macrobrachium idella
Macrobrachium kulsiense
Macrobrachium naso
Macrobrachium peguensis
Macrobrachium pilimanus
Macrobrachium scabriculum
Macrobrachium sp. 'Himalayanus'

Macrobrachium sp. 'Ivory'
Macrobrachium Sp./Bicolour Shrimp
Macrobrachium Sp./Black Leaf Shrimp
Macrobrachium Sp./Green Leaf Shrimp
Macrobrachium Sp./Pigeon Blood Shrimp
Macrobrachium Sp./Red Claw shrimps
Macrobrachium Sp./Redtail Fancy Shrimp
Macrobrachium tiwari
Palaemon emeraldi
Palaemon hendersoni
Palaemon scabriculus
Palaemon scarletti
Palaemon sp. 'green needlenose'
Palaemon sp. 'Yellow fluorescent'
Palaemon Sp./Blue Band Shrimp
Palaemon Sp./Green Rocket Shrimp
Penaeus brasiliensis
Zico Shrimp

The major indigenous freshwater ornamental fish species exported during 2005-2010 is shown in Table 5.

Table 5: Indigenous species exported (2005-2010)

SPECIES	COMPOSITION
*Tetraodon travancoricus**	15.51%
Dario dario	4.81%
Puntius denisonii	3.76%
Botia striata	3.69%
*Carinotetraodon imitator**	1.59%
Puntius fasciatus	0.54%
Channa bleheri	0.49%
Chela dadiburjori	0.30%
Mesonoemacheilus triangularis	0.19%
Puntius terio	0.13%
*Etroplus maculatus**	0.12%
Puntius filamentosa	0.10%
Puntius jerdoni	0.09%
Pisodonophis boro	0.09%
Puntius narayani	0.07%
Puntius melanampyx	0.07%
*Pseudosphromenus dayi**	0.07%
Puntius conchonius	0.05%
Barilius bakeri	0.03%
Badis assamensis	0.02%

Recent trade statistics from Ministry of Commerce, Government of India, indicate that the export demand for ornamental fish is declining (Fig 1.). The annual growth rate and compound annual growth rate also indicates a decline in the exports which is visible from Table 6.

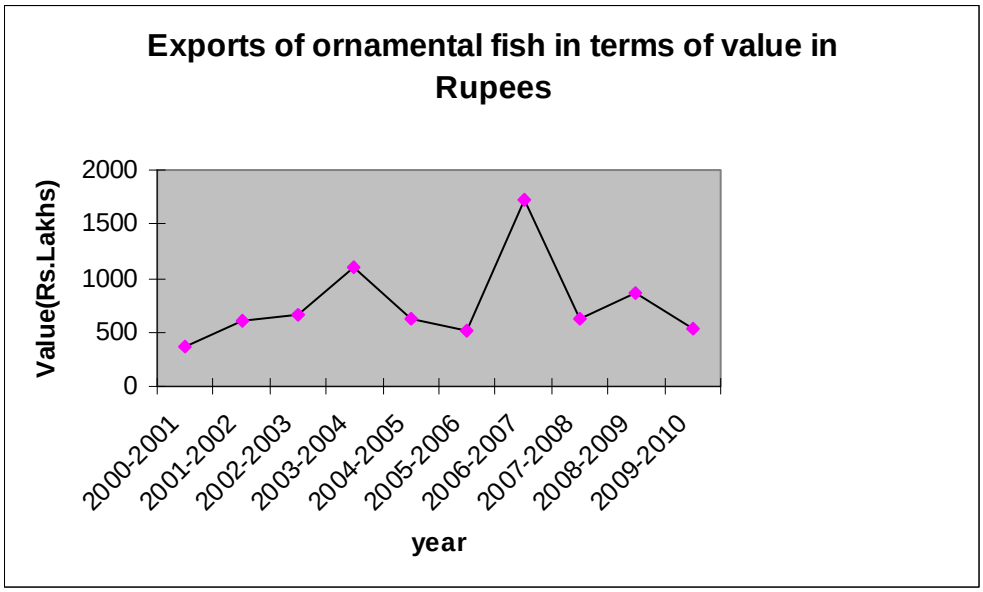

Fig 2: Exports of Ornamental fish in Terms of Value in Rupees (Lakhs)

Source: Compiled using data from the Ministry of Commerce, GoI.

Table 6: Annual Growth Rate and Compound Annual Growth Rate of Ornamental fish Exports in Terms of Value in Rupees

Year	Annual Growth (%)	Compound Annual Growth Rate (%)
2000-2001		
2001-2002	63.93	63.94
2002-2003	9.2	33.8
2003-2004	66.48	43.91
2004-2005	-43.84	13.74
2005-2006	-16.69	6.87
2006-2007	234.38	29.25
2007-2008	-64.04	7.66
2008-2009	38.94	11.14
2009-2010	-39.2	3.936

Source: Computed by the author

Though the exports increased twice, it declined substantially after 2007-2008. The reasons could be due to drastically reduced exports to Singapore, which is considered to be the main importer of Indian ornamental fish (Rana, 2007), from Rs.1079.22 lakhs in 2006-2007 to Rs. 252.42 lakhs. A dip in the exports from Singapore, Thailand and Malaysia in 2008 can also be one of the reasons. Though Thailand has revived from this dip, Singapore and Malaysia has not come out of this dip yet (Ploeg, 2013). In India, the price fetched for most of the ornamental fishes are at par with the export price. This is one of the reasons for slowdown

of exports of ornamental fishes. Shipments costs, low volume of large number pf species and non standardisation of size in shipments cause less demand for consignments from India (Sekharan, 2006).

Table 7 shows the exports of ornamental fish from India to different countries for the past ten years.

Table 7: Exports in terms of Value in Rupees (Lakhs)

Country	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
France	1.94	3.83	4.18	3.06	1.62	1.53	2.52	1.01	0.02	7.86
Germany	27.31	16.45	26.31	28.09	37.01	30.36	27.99	34.8	41.67	54.02
Hongkong	69.59	104.89	10.18	59.44	80.55	60.49	52.96	45.1	42.58	47.72
Japan	100.29	58.25	198.17	406.47	56.82	48.08	52.59	40.46	67.21	46.69
Malaysia	7.99	1.71	2.97	224.35	25.23	87.05	52.23	53.4	38.53	39.07
Netherlands	8.92	4.26	7.48	7.49	8.51	12.36	18.05	15.49	12.35	14.58
Singapore	60.01	50.99	66.89	82.14	140.53	134.9	1,079.22	252.42	265.43	172.01
Srilanka	0.66	11.54	4.4	5.56	2.28	3.62	2.18	4.13	0.33	0.56
Taiwan	3.64	252.34	3.17	34.64	19.87	7.93	3.2	2.1	5.08	6.42
Thailand	14.24	3.43	80.49	3.3	9.47	7.17	39.45	0.6	1.21	16.06
UAE	1.34	6.09	20.08	40.26	14.1	3.55	205.05	40.5	232.69	1.43
UK	11.33	12.58	73.83	21.93	24.08	10.65	21.56	33.49	13.44	15.27
USA	53.87	69.79	72.62	93.93	66.73	58.45	44.59	37	46.11	56.96

Source: Computed using data from the Ministry of Commerce, GoI.

3.3.2 Estimating production function

From the multiple regression analysis for production function, as shown in Table 8, 96.2% variability in the data can be explained based on these variables (R^2= 0.962, $p<0.001$).

Table 8: Multiple Regression analysis

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.980936645
R Square	0.962236702
Adjusted R Square	0.956841945
Standard Error	0.104384257
Observations	25

ANOVA					
Df	*SS*	*MS*	*F*	*Significance F*	
Regression	3	5.830439624	1.943479875	178.3652	4.26E-15
Residual	21	0.228817534	0.010896073		
Total	24	6.059257158			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	2.564869791	1.153766935	2.223039779	0.037324	0.16548
X Variable 1	0.917684952	0.046574992	19.70338397	5.06E-15	0.820827
X Variable 2	-0.279788399	0.269739527	-1.037253987	0.311414	-0.84074
X Variable 3	-0.049470778	0.262323922	-0.188586605	0.852227	-0.595

The regression equation was, Q=2.56+0.92X1-0.28X2-0.049X3

The equation of production can be converted to

Log Q= log A+ a log K+ b log L+ c log M..... Eq. (1)

From the table the values can be substituted for eq. 1

Log Q= 2.56 + 0.92 log K -0.28 log L -0.049 log M.....Eq. (2)

Intercept= log A= 2.56

$A = e^{2.56}$

= 12.94

Therefore, $Q= 12.94\ K^{0.92}\ L^{-0.28}\ M^{-0.049}$

Eq (2) can be interpreted in another way too. Substituting the following variables

Log Q= Y

Log K= X_1

Log L= X_2

Log M= X_3

Hence Eq. (2) can be rewritten as:

$Y= 12.94 +0.92\ X_1 -0.28X_2 -0.049X_3$

When X_1 increases by 1% on an average, Y will increase by 0.92% keeping X_2 and X_3 constant. Similarly, Y decreases by 0.28% and 0.05% when X_2 and X_3 increases by 1% on an average.

The quantity exported increased as the capital investment increased, which hint towards better infrastructure, better management practices, better stocking density, better quality management that increases the capital investment of the export firm. But higher capital investment led to decreased labour and miscellaneous costs. Higher capital investment was due to the use of better machines and equipments that paved way for lesser labour and operating costs. Increased operating costs in many firms were due to the lack of equipments and machinery like packing machines,

compressors, blowers, etc. Besides this, effective utilization or over utilization of the manpower is also a reason for decreased labour. This can be illustrated with a simple example. Suppose a unit has got 10 tanks which are washed by 5 labourers. That is, 2 tanks are washed by 1 labour. But in second unit there are 30 tanks which are washed by 5 labourers. That is 6 tanks are washed by 1 labour. In the second case capital investment is higher as there are more tanks, but the number of labourers is the same. In the second case there is better or over utilization of labourers. Using better technology that causes higher capital investment reduces the operating costs.

3.4 Conclusion

Ornamental fish industry has enormous potential in tropical countries and provide limitless opportunities to India. Beyond the fact that ornamental fish industry contributes to the international fish trade, it also provides a source of income to rural and coastal communities. But the growing trade has started raising sustainability issues as relevant as in food fish (Olivier, 2003). Hence, Silas *et al.* (2011) recommends three pre-requisites for the prosperity of the trade which are quality, quantity and sustainability. Higher capital investment

can promote greater export quantity, but the quantity is always dependent on the quality. Hence improving the quality can help in reviving the exports.Proper fish health management and quarantine regimes will also have to be adopted. Besides these, to achieve sustainability in an ornamental fish industry, policies should also take into account the interests and welfare of the stakeholders associated with the industry.

CHAPTER 4

SUSTAINABILITY ISSUES AND SUSTAINABILITY INDICATORS ALONG THE CHAIN OF CUSTODY

4.1 Introduction

The last decade has witnessed an increase in the attempts to harness science and technology in the quest for a transition towards sustainability. Around 20 years ago, the patterns of economic growth were hardly questioned. But now it has become imperative to keep track of the paths taken for economic and social development.

4.1.1 Sustainability - Definitions

Perhaps the most extreme meaning for the concept of sustainability is that of 'static equilibrium' (Costanza, 1991). Sustainability was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). According to this definition it is used as a process and includes ecological, social and economic dimensions (Costanza and Patten, 1995). Sustainability has got many definitions according to different perspectives. According to WWF (1991) definition of sustainable development is "Improvement in the quality of human life within the carrying capacity of supporting ecosystems" which is less ambiguous than the definition put forward by Brundtland Commission (Goodland, 1995). The following are the popular definitions of sustainability.

Table 9: Popular definitions for sustainability

The sustainable society is one that lives within the self-perpetuating limits of its environment. That society is not a "no growth" society. It is rather, a society that recognizes the limits of growth [and] looks for alternative ways of growing.	Coomer (1979)
Sustainable development – development that is likely to achieve lasting satisfaction of human needs and improvement of the quality of human life.	Allen (1980)
Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.	UN(1987)
Sustainable development – economic development that can continue indefinitely because it is based on the exploitation of renewable resources and causes insufficient environmental damage for this to pose an eventual limit.	Allaby (1988)
The sustainable development concept constitutes a further elaboration of the close links between economic activity and the conservation of environmental resources. It implies a partnership between the environment and the economy, within which a key element is the legacy of environmental resources that is not "unduly" diminished.	OECD (1990)
Sustainable development: The amount of consumption that can be sustained indefinitely without degrading capital stocks, including natural capital stocks.	Costanza and Wainger (1991)
Sustainable development means improving the quality of life of humans, while living within the carrying capacity of supporting ecosystems.	IUCN/UNEP/ WWF (1991)
Sustainability is defined as leaving to the future ' the option or the capacity to be as well off as we are'	Solow (1991)

4.1.2 Fisheries and sustainability

History of fishing implies that humans have impacted fish populations and the associated ecosystem over a long time. Fisheries have rarely been sustainable due to improved technology, geographic expansion and exploitation of previously spurned species lower in the food web (Pauly *et al.*, 2002).

Ornamental fish cater to the hobbyist interests of many people. The very first fish keepers lived in the Middle Eastern cultures of Assyria, Sumeria and Mesopotamia some 4000 years ago (Fossa, 2012). Fish keeping has since then evolved into one of the biggest hobbies in the world and is second only to photography. The increasing demands of fish led the hobby to an industry, facilitating commercial import and export.

According to Conroy (1975) no information was available as far as the ornamental fish trade from India was concerned. But in 2010-2011, India exported ornamental fish worth 1.26 million USD. During 2010-2011 as per the quantity exported, according to the port wise exports, Kolkata took first position, while Kerala (Kochi and Thiruvananthapuram ports) took the second position (Nair, 2012). From the 20 major exported indigenous species from India (Personal communication, MPEDA), 4 species are

endemic to Kerala and 4 are found to occur in Kerala along with other states. Thus it would be appropriate to study the sustainability issues along the chain of custody of wild caught ornamental fish exported from Kerala.

Chain-of-custody and traceability are integral parts of any successful ecolabelling schemes. While traceability has been defined as "the ability to systematically identify a unit of production, track its location and describe any treatments or transformations at all stages of production, processing and distribution" (AMRL, 2005), chain-of-custody involves a set of measures which is designed to guarantee that the ecolabelled product put on the market is really a product coming from the certified fishery concerned (FAO, 2005). Hobday *et al*. (2004) and Smith *et al*. (2007) provide a series of indicators and reference points for use in fisheries ecological risk assessment. The qualitative and semi-quantitative levels of this risk assessment methodology do not require estimation of total catch, stock abundance as they are based on the general characteristics of the species, the ecosystem and the fishing operations. But no such sustainability indicators or criteria are formed for ornamental fish sector.

4.1.2.1 International Organizations regulating ornamental fish trade

Freshwater Fish Specialist Group (FFSG) - The FFSG was established in 2004 when IUCN's Species Survival Commission (SSC) and Wetlands International (WI) identified the need for a global network of experts on freshwater fishes. This network of expert volunteers provides authoritative and up-to-date information on the global conservation status and distribution of freshwater fishes (FFSG, 2013).The information on the conservation status and distribution of freshwater fishes helps to maintain database which can be used for the conservation of threatened fish species.

International Union for Conservation of Nature (IUCN)

International Union for Conservation of Nature (IUCN) is the world's oldest and largest global environmental organization. IUCN prepares Red Data Book which lists the threatened and endangered faunal species. The Red Data Book also lists some of the Indian freshwater ornamental fish species which includes *Puntius denisonii* (IUCN, 2013 b)

Ornamental Fish International

Ornamental Fish International (OFI), founded on 1 June 1980, is the worldwide trade association representing all sectors of the ornamental aquatic industry in some 46 different countries worldwide. OFI was mainly found to address the concerns in the international aquatic industry. One of its missions is to promote the aquatic trade by adhering to the ethical trading standards (OFI, 2012).

European Pet Organization (EPO)

The European Pet Organization is the European organization with which national pet trade associations in Europe collaborate in order to strengthen their position on European and other international issues (EPO, 2011).

CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Widespread information nowadays about the endangered status of many prominent species, such as the tiger and elephants, might make the need for such a

convention seem obvious. Because the trade in wild animals and plants crosses borders between countries, the effort to regulate it requires international cooperation to safeguard certain species from over-exploitation. CITES was conceived in the spirit of such cooperation. Today, it accords varying degrees of protection to more than 35,000 species of animals and plants, whether they are traded as live specimens, fur coats or dried herbs (CITES, 2011).

The study aims to

1. Find the chain of custody of wild caught ornamental fish exported from Kerala and highlight the major sustainability issues along the chain of custody
2. List out the suitable sustainability criteria and indicators for the wild caught indigenous ornamental fish exported from India which were then analyzed for their interactions, connections, linkages and relationships.
3. Compare the sustainability assessment of the three major exported wild caught indigenous species- *Tetraodon travancoricus*, *Dario dario* and *Puntius denisonii*, from India.

4. Analyze the effectiveness of the regulation which was released on November 5, 2008 (GO. (Rt) No.633/08/F&PD) by Kerala government.

The objectives are relevant in this regard as they will be the first work to investigate the sustainability issues in the ornamental fish sector and also to explore the amount of database available for the three most sought after wild caught indigenous ornamental fish which have a position in the Red Data Book of IUCN.

4.2 Methodology

4.2.1 Studying the chain of custody

To find the prevailing conditions in the ornamental fish industry a pre-survey, which included fish collectors, fish dealers and exporters, was carried out among the stakeholders. Using the observations and results of the pre-survey, a primary survey adopting Personal Interview Method (Churchill, 1995), with the help of a structured questionnaire, was carried out. The survey was carried out along three CoC's in Kannur,

Chalakuddy and Alappuzha. The chain of custody was established through exporters. From exporters a back tracing was done to find their suppliers and finally reaching the fishermen. The sustainability issues, identified from the pre-survey, were evaluated in terms of their degree of importance by ranking each issue. 25 stakeholders (5 fish collectors, 8 collectors cum exporters, 6 fish dealers and 6 exporters) at various stages of the chain of custody were asked to rank these issues based on their rate of accepting the issue and also in terms of marking the most prioritized issue according to each stakeholder. The most prominent issue was asked by the stakeholder to be ranked 1 and the ranks decreased subsequently based on the decreasing order of prominence of the issues. These ranks were then analyzed using Garrets Ranking Technique (Garret &Woodworth, 1966) as mentioned in section 2.6.2.

4.2.2 Linking the sustainability indicators

The sustainability indicators were formed according to the steps followed in IOC Manual, 2006. Then a qualitative method called cognitive mapping

(Eden and Akermann, 1998) was used to find the interactions between the criteria and the indicators. Refer section 2.7.2 of chapter 2.

4.2.3 Comparative sustainability assessment

Unpublished export data for the years 2005-2010 were collected from MPEDA and the three most exported species were identified after compiling and analysing the data. These three species were then subjected to sustainability assessment against the sustainability indicators formed according to IOC Manual, 2006. Based on the available information with respect to the indicators for the three species, scores were given modifying Huntington *et al.* (2004). The scores given were'?' denotes insufficient information/ grey literature, '0' denotes no information, '1' denotes partial information available but still information gaps exist and '2' denotes almost all information available . Primarily, a desk based study was done to gather the available information. Structured personal interviews were also conducted to confirm facts.

4.2.4 Analysing the effectiveness of the Kerala government order on conserving *Puntius denisonii*

Export invoices after 2008 primarily had only group names and no species name. This tendency was mainly seen in the exports of indigenous fish and not in the case of exotic fish species. Also after the declaration of the regulation in November 2008 to conserve *Puntius denisonii,* there was an increase in the number of exports in the labels like barbs, colored barbs, and assorted barbs. Evidences were obtained that denisonii was exported in the labels like barbs and colored barbs. To prove this statistically T-test was done. Weekly average price and quantity of *Puntius denisonii* and barbs were calculated. T-test was used to compare the correlation coefficient of price and demand of *Puntius denisonii* before and after introducing the regulation. The same test was followed for comparing the price and demand of barb before and after regulation. Also, correlation coefficient of price and demand between *Puntius denisonii* and barbs before regulation was compared with the same after regulation.

4.3 RESULTS & DISCUSSION

4.3.1 Studying the chain of custody

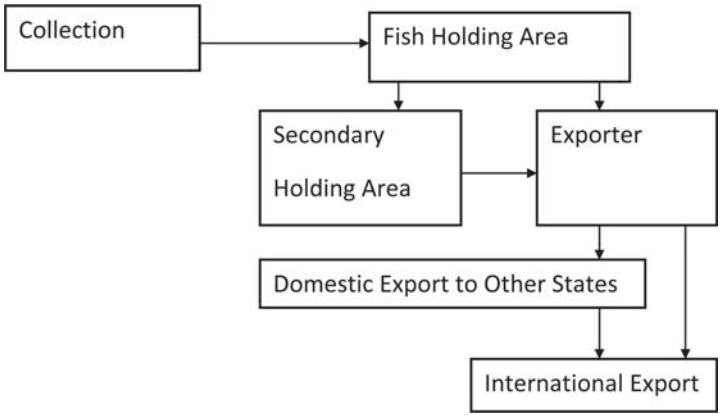

Fig 3: Stages in the chain of custody of wild caught ornamental fish exported from Kerala (*Source: Primary Survey)*

Different stages in the chain of custody of wild caught ornamental fish exported from Kerala are depicted in Fig.3. At the collection stage, different types of fishing gears such as cast nets, seine nets, and even electric methods were used to collect fish. Fish collectors usually stay near the rivers from where the fish is collected. The first holding area is usually a place in the premises of the house of the fish collector or a

place adjacent to the river from where the fish is collected. Secondary holding areas are not a compulsory part in the chain of custody. Second holding areas come in the CoC when the fish have to be transported from the first holding area prior to the exporting facility. Usually they are provided by the wholesalers or fish collectors from far off places. Though quarantine facilities were available in these holding areas, infrastructural facilities were poor with no proper sanitary measures.

Water quality was rarely tested, especially in the first holding area. From these holding areas, the fish were transported to the exporting facility based on the orders placed by the exporter. The fish were transported mostly in trains for long distances and in motor vehicles for short distances. No air-conditioning was provided in trains but in motor vehicles air conditioning was provided seldom. The fish were packed in polythene bags filled with oxygen and placed in cartons with no polystyrene packing. The cartons were sealed and tied. It was noticed that, on arrival in the exporting facility, most of the cartons were damaged and seals almost broken. The bags were insufficiently aerated, with high packing density and as a result, the fish were found to

be in stress on arrival. The fish were then kept for quarantine for nearly 10 days at the exporting facility. During this period, water quality was checked, disease outbreaks were noted and appropriate medicines were given. More chances of disease outbreaks were seen at this stage rather than at the holding areas.

Exporters advocate that high incidence of disease was due to improper transportation, poor packing, and poor handling at the initial stages. From the exporting facility, the fish were packed for exports. For fish like *Puntius denisonii*, before packing for exports, a process called pre-packing was done. Pre-packing was found to reduce the stress and further mortality. The fish was pre-packed in polythene bags with water containing 10 ppm tetracycline and vitamin B capsules. After pre-packing, they were kept in lower temperature environments. Just before exports, UV sterilized freshwater was filled in aerated polythene bags and packed for exports.

4.3.1.1 Garret ranking of identified sustainability issues

Along the CoC, 18 major sustainability issues were identified. Of these, poor water quality was identified by the stakeholders to be the biggest threat causing mortality and degrading the quality of the ornamental fish (Mean Garret Score of 74.76). Major sustainability issues along the chain of custody and results of Garret ranking are given in Table 10.

Poor water quality, lack of technical knowledge and improper transportation were the issues with maximum scores. Some issues like by catch and exports during spawning time, though they were persistent, fetched low scores as stakeholders were reluctant to admit such incidences. Many issues like water quality, lack of technical knowledge, improper transportation, improper handling, disease outbreaks, and lack of proper guidelines, infrastructure and sanitary measures were common in all stages of CoC. The maximum issues were at the collection stage which included by catch, catching fish during breeding time, use of improper gears, collecting juveniles, and poisoning water for catching food fish, lack of technical knowledge, improper transportation, improper handling,

disease outbreaks, no proper guidelines, poor infrastructure and sanitary measures.

Table 10: Major sustainability issues along the CoC and results of Garret ranking

Rank	Sustainability Issues	Mean Score
1	Poor water quality	74.76
2	Lack of technical knowledge	73.08
3	Improper transportation (high packing density, less aeration, improper timing, stress)	71.36
4	Mortality due to improper handling	66.32
5	Improper gears	63.92
6	Disease outbreak	63.44
7	No proper infrastructure	58.16
8	No proper guidelines	50.96
9	Collecting juvenile fish	49.68
10	No basic information available	48.32
11	No standard sanitary measures	47.40
12	No effort for captive breeding indigenous species while breeding abroad	45.52
13	By-catch	43.88
14	No proper quarantine	43.68
15	Exports during breeding time	39.20
16	Use of impermissible antibiotics while packing	31.48
17	No organizations for collectors	29.32
18	Poisoning of water for catching food fish	29.20

4.3.2 Linking the sustainability indicators

The sustainability indicators were formed for the wild caught indigenous ornamental fish exported from India. Four criteria were formed namely ecological with 11 indicators, governance with 4 indicators, socio-economic with 9 indicators and technical with 3 indicators as shown in Table 11.

Table 11: Sustainability Criteria and indicator

Criteria	Variable	Indicators
Ecological	A1	Distribution
	A2	Stock Assessment
	A3	Species Biology
	A4	Reproduction Biology
	A5	Spawning
	A6	Exploitation rate
	A7	Impact of ecosystem factors relevant to target species
	A8	Interaction with other species
	A9	Use and impacts of gear
	A10	Fishing grounds
	A11	Risk factors known and understood

Governance	B1	Specific fisheries management objectives
	B2	Measures to discourage destructive fishing practices
	B3	Economic instruments for management policies like certification
	B4	International recommendations or guidelines influencing the industry
Socio-economic	C1	Value of catch
	C2	Quantity of catch
	C3	Quality of catch
	C4	Income at each stage
	C5	Fishery contribution (domestic, exports)
	C6	Total employment
	C7	Fisher demographics
	C8	Management by local and indigenous communities
	C9	Manifestation of traditional knowledge
Technical	D1	Measures to reduce transport stress and mortality
	D2	Optimum physical and chemical properties of water suitable for the target species
	D3	Captive breeding technology

For the holistic assessment of the relationships between the indicators, using cognitive mapping, a causality map was generated as shown in Fig. 4. Table 12 gives the important information regarding the domain and centrality of indicators.

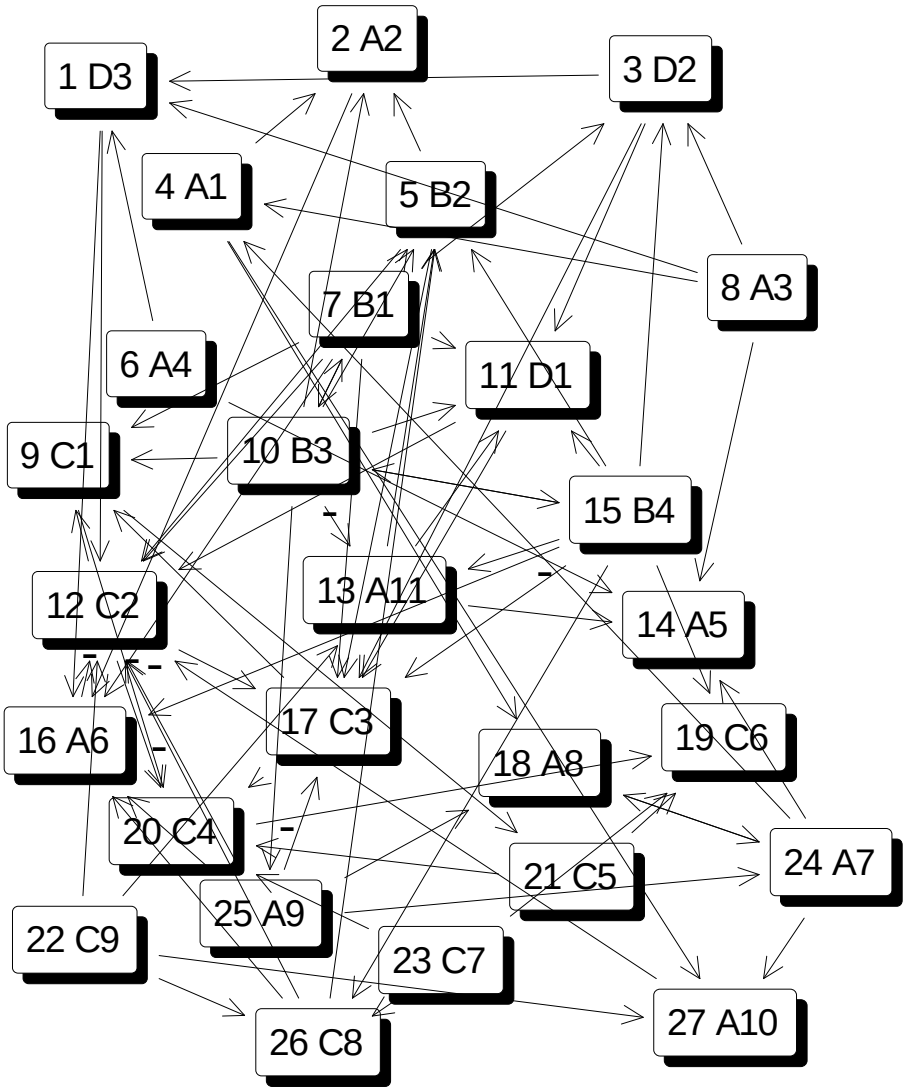

Fig 4: Figure showing the interactions and linkages between the sustainability indicators

Table 12: Domain and central scores for the indicators.

Criteria	Variable	Indicators	Domain	Central Score
Ecological	A1	Distribution	5	12
	A2	Stock Assessment	4	13
	A3	Species Biology	4	12
	A4	Reproduction Biology	2	10
	A5	Spawning	4	11
	A6	Exploitation rate	7	15
	A7	Impact of ecosystem factors relevant to target species	6	12
	A8	Interaction with other species	4	11
	A9	Use and impacts of gear	6	14
	A10	Fishing grounds	4	13
	A11	Risk factors known and understood	6	15
Governance	B1	Specific fisheries management objectives	9	15
	B2	Measures to discourage destructive fishing practices	8	15
	B3	Economic instruments for management policies like	10	15

		certification		
	B4	International recommendations/guidelines influencing industry	10	16
Socio-economic	C1	Value of catch	6	15
	C2	Quantity of catch	12	18
	C3	Quality of catch	9	17
	C4	Income at each stage	6	14
	C5	Fishery contribution (domestic, exports)	3	9
	C6	Total employment	4	11
	C7	Fisher demographics	3	10
	C8	Management by local and indigenous communities	6	14
	C9	Manifestation of traditional knowledge	4	13
Technical	D1	Reduce transport stress and mortality	7	15
	D2	Optimum physical and chemical properties of water suitable for the target species	6	14
	D3	Captive breeding technology	5	14

In terms of domain, 15 out of 27 indicators have at least a density of six. Among this 15, five are from socio-economic criteria, four each from governance and ecological and two from technical. C2 (quantity of catch) under the socio-economic criteria has the highest domain and the central score. So arguably this indicator, that is quantity of catch, would be the central of sustainability issues for the wild caught indigenous ornamental fish exported from India.

4.3.3 Comparative sustainability assessment

Comparative sustainability assessment scores of three major indigenous wild caught ornamental fish species is given in Table 13. On comparing the sustainability, it was found that most of the information was in the form of grey literature or no research has been done on these species. More scientific works have been done in the case of *Puntius densionii* than the other two species. This may be due to its high demand in the export market (Prasad *et al.*, 2008 and Mittal, 2009). When sustainable issues are debated on one side, on the other side there is no baseline information on *Tetraodon travancoricus* assessed as vulnerable, *Dario dario* assessed as data deficient and *Puntius denisonii* assessed as

endangered (IUCN, 2012) which are also the three most important indigenous wild caught ornamental fishes of India (See Table 5) (MPEDA, Personal Communication).

Table 13: Comparative sustainability assessment scores

Criteria	Indicators	*Tetraodon travancoricus*	*Dario dario*	*Puntius denisonii*
Ecological	Distribution	2	2	2
	Stock assessment	0	0	0
	Species biology	0	0	1
	Reproduction biology	0	0	1
	Spawning	?	?	1
	Exploitation rate	0	0	1
	Impact of ecosystem factors relevant to target species	0	0	0
	Interaction with other species	?	0	0
	Use and impacts of gear	0	0	0
	Fishing grounds	2	2	2
	Risk factors known and understood	1	?	1
Governance	Specific fisheries management objectives	0	0	1
	Measures to discourage destructive fishing practices	0	0	0
	Economic instruments for management policies like certification	1	1	1
	International recommendations or guidelines influencing the industry	1	1	1
Socio-economic	Value of catch	1	1	1
	Quantity of catch	0	0	0

	Quality of catch	0	0	0
	Income at each stage	0	0	0
	Fishery contribution (domestic, exports)	1	1	1
	Total employment	?	?	?
	Fisher demographics	0	0	0
	Management by local and indigenous communities	?	?	?
	Manifestation of traditional knowledge	?	?	?
Technical	Measures to reduce transport stress and mortality	?	?	1
	Optimum physical and chemical properties of water suitable for the target species	1	1	1
	Captive breeding technology	0	?	1
Summary	?	6(22.2%)	7(25.9%)	3(11.1%)
	0	13(48.1%)	13(48.1%)	9(33.3%)
	1	6(22.2%)	5(18.5%)	13(48.1%)
	2	2(7.4%)	2(7.4%)	2(7.4%)
	Total	27(100%)	27(100%)	27(100%)

4.3.4 Analysing the effectiveness of the Kerala government order on conserving *Puntius denisonii*

After the introduction of the regulation, the quantity of *Puntius denisonii* exported showed a clear, well defined decline. But on the other side, the quantity of barbs exported after regulation nearly doubled, which is visible from Table 14.

Table 14: Figures showing the export of *Puntius denisonii* and barbs before and after the regulation

Barb before Regulation		*Puntius denisonii* before Regulation	
Year	Quantity(numbers)	Year	Quantity
2004	41074	2004	108464
2005	5760	2005	16224
2006	69688	2006	155300
2007	60220	2007	14837
2008	60979	2008	6099
Barb after Regulation		*Puntius denisonii* after Regulation	
2008	23732	2008	210
2009	164210	2009	7833
2010(until June)	152035	2010	5155

Comparison of correlation coefficient between price and demand of *Puntius denisonii* before and after regulation showed a significant difference ($t=8.644$, $p<0.01$). No significant difference between the correlation coefficient of price and demand of barbs before and after regulation was

observed ($t=1.1689$, $p>0.05$). Comparison of correlation coefficient of price and demand between *Puntius denisonii* and barbs before the regulation showed no significant difference ($t=1.8163$, $p>0.05$). But after the regulation, there was a high significant difference ($t=9.4828$, $p<0.01$). This clearly indicates that there are chances that *Puntius denisonii* is getting exported under various labels like barbs and colored barbs.

Sekharan (2006) has studied the distribution channel of indigenous ornamental fishes of kerala. The fish collected moved through four different channels- either to a supplier or directly to exporter, or domestic aquarist or local fish vendor. In the present study an important difference is in the lack of a food fish market for these indigenous ornamental fishes. This could be because of the fact that indigenous fish catch has been terribly reduced as reported by some respondents.The chain of custody as revealed in the present study has become smaller when compared to the chain mentioned in the study of Sekahran (2006). Also visible reduced distribution of indigenous fish into domestic market is also noticable in the present study. Hence the present study highlights a major fact that indigenous ornamental fish collection and trade has reduced visibly which is evident from the shorter chain of custody, a not so prominent

domestic market, and no market as food fish. The results of the Garret ranking show that majority of the mortality and stress of ornamental fish was caused due to poor water quality, lack of trained personnel and improper transportation. To compensate the DOA, higher quantities of fish are being caught, which threatens the sustainability of the resources. This stresses the fact that quantity of ornamental fish caught is the central of sustainability issue. As far as exports of ornamental fish is considered there are no clear data on the quantity exported and the only data recorded are the weight of the boxes in which the live fish are moved and the value of these shipments in USD (Ploeg, 2009). Higher DOA has been found to be one of the weaknesses of the indigenous species exported during the SWOT analysis (Sekharan, 2006). Olivier (2001) has mentioned mortalities of 25-40% in every step of the transport chain, resulted in a total mortality of up to 73% for the total transport chain. Rubec and Cruz (2005) has highlighted certain reasons for the mortality of marine ornamental fish during shipment which includes capture with cyanide which caused 50% of the acute mortality, and 30% mortality on average at each step of the chain of custody. The sustainability assessment shows that there are still questions over the wider sustainability of the species, given the lack of information on stock size,

management regimes, and on the impact of the fisheries on socio-economic aspects. It is therefore impossible to conclude whether the fishery is sustainable or not. So, a strong database has to be built which can help in scientifically and accurately assessing the plight of the ornamental fish.

The fact that *Puntius denisonii* is getting exported under various labels like barbs and colored barbs indicates that the conservation initiative form Kerala Government does contains certain flaws, which were overlooked.

FLAWS IN THE REGULATION

- *Puntius denisonii* is endemic to the streams and rivers of northern Kerala and the adjoining western fringes of Karnataka and Tamil Nadu (Molur *et al.*, 2011). A regulation in Kerala alone cannot help the conservation because the fish can be caught and exported from Karnataka and Tamil Nadu too. Also trade in other labels can also happen. A conservation measure initiated for a fish that is found in three states should not be confined within the geographical boundary of one state.
- No fishing quotas were issued to traders as per the regulation (Pramod, 2009)
- It is found from the export invoices that the fish is also caught during its breeding season and it's immaterial that

whether the fish is caught from Kerala, Karnataka or Tamil Nadu.

4.4 Conclusion

It is easier for India to adopt approaches to maintain sustainability as India is at an infant stage as far as ornamental fish exports are concerned. Market based incentives like ecolabelling and certification are gaining importance in fisheries. They are also a response to the growing demand from the key importing nation retail markets for more sustainably produced fish. This pressures the industry to adopt more sustainable fishing practices. However, the extent to which such initiatives become successful is questionable (WWF, 2009). Substantial subsidies for basic infrastructure development should be promoted (Nair, 2002). The need for measuring and assessing the sustainability of fishery activities has acquired great importance and should be undertaken at various levels involving all aspects in fishery system (Adrainto *et al.*, 2005). Management measures and regulations can be best implemented if the industry is studied well and is strongly supported by database. Only then effective management measures can be developed and implemented.

CHAPTER 5

COMPLIANCE COST STUDY AND STAKEHOLDER ATTITUDE ON THE IMPACT OF CERTIFICATION- A CASE STUDY USING GREEN CERTIFICATION

5.1 INTRODUCTION

Oceans, lakes, rivers and streams are rich sources used by mankind since time immemorial. The efforts by the human kind to tap into and use these resources are so extensive that they have resulted in the over-exploitation and have come to pose a threat to many aquatic organisms. The social

consequences of this are also often high, with fishery communities being unable to derive livelihoods from the marine environments that have supported them for decades and sometimes even centuries (Auld, 2007). Information on the environmental impact of producing or using specific products in the form of an eco-label was first encouraged by national multi-issue labeling schemes (Gulbrandsen, 2005).Eco-labels are derived from certification processes and are a market based approach that attempt to influence consumer behaviour toward fisheries products that are generated through sustainable practices (Potts and Haward, 2007). This type of certification, originally defined simply as "making relevant environmental information available to appropriate consumers" (USEPA 1993), is meant to provide consumers with the opportunity to express their environmental and ecological concerns through choice of products.

Ecolabels are labels given to those products and services that are considered environmentally superior to other functionally and competitively similar products. The ISO defines three types of ecolabels. Type I labels compare products with others in the same category, awarding labels to those that are environmentally preferable throughout their whole life cycle. Type II labels are environmental claims

made about goods by their manufacturers, importers or distributors. Type III labels provide a menu of a product's environmental impacts throughout its life cycle (UNEP, 2000). In recent years, a new class of sector/issue-specific "green" certification programs has emerged and become a particularly vibrant source of Type I voluntary labeling. Perhaps best described as a hybrid between an environmental management system (EMS) standard and an eco-labeling scheme, this type of labeling is based on third-party verification of compliance with sector/issue-specific performance criteria for environmental management practices (Gulbrandsen, 2005). Environmentalists see ecolabeling as a potential way to create economic incentives for environmental improvements. Producers see ecolabeling as a potential way to tap the growing segment (Blend and Ravensawaay, 1999).

Taylor (2001) has mentioned that the costs for certification are non-linear and there is a possible comparative disadvantage for small- and medium sized enterprises. Meuwissen *et al.* (2003) discusses about the costs and benefits of certification. Though the study has listed three benefits of certification which are positive effect on trade, enhanced license to produce and price premium, says that these benefits are questionable. The challenge with ecolabels

is that labeling organizations must make a greater effort to communicate relevant information, rather than simply more information to consumers at the point of sale the easiest metrics to report are usually not very informative (Chatterji and Levine 2006). Macfadyen and Huntington (2007) discusses about the various assessment and certification processes in Marine Stewardship Council certification that would incur costs which includes pre-assessment; the fishery assessment; re-assessment; chain-of-custody assessment; and logo license fees (not paid to the certification body). Studying on the impacts of forest certification (Chen *et al*., 2010) highlights how certification can be a costly exercise, even though it is intended to promote the sustainability of forest lands and forest management. Though the process is costlier the economic benefits may not be immediately clear. The study focuses on the three most important market benefits which are potentially market access, improved public image and price premiums. The forest certification could enable certified forest products to penetrate some environmentally sensitive market niches and by maintaining and enhancing the public image of forestry companies, but the price premium has proved difficult to realize, especially for commodity products such as pulp and structural lumber. When considering the actual purchasing behaviour of consumers,

there is little evidence to verify that the expressed willingness to pay a price premium will materialize in the market place.

The most effective certification efforts pay attention to demand for and supply of sustainable product. Failure to balance demand and supply adequately is likely to create significant frustration in the marketplace, which can kill a certification program before it starts (Searle *et al.*, 2004). The absence of data and the difficulty of assessing causality make it very hard to assess the impact of eco-labelling on actual environmental performance improvements. From a policy perspective, 'effectiveness' can be measured in terms of environmental improvements; but from a practical standpoint, success is almost always assessed in terms of proxy indicators that suggest the ecolabel's scope of influence rather than its impact. Environmental and socioeconomic impacts of sustainable certification of agricultural commodities, tourism operations, and fish and forest products have been studied in broader concept (Rice and Ward, 1996; Giovannucci and Ponte, 2005 and Blackman and Rivera, 2010).

The present study was a scoping exercise into the wider impacts of the certification. But studying a wider impact of certification was difficult and at the same time uncertain in

their outcomes. Hence, the chapter focused on two lines of enquiry:

1) The probable compliance cost while adopting the certification was studied - A case study method using Green certification.

2) Scaling the attitude of stakeholders on the environmental impact of Green Certification.

5.2 Methodology

5.2.1 The probable compliance cost study

The first probable impact of the certification scheme was studied in terms of compliance cost. Hence a compliance cost study was done adopting case study approach (Tellis, 1997) using the guidelines of Green Certification developed by MPEDA (Silas *et al.*, 2011) The compliance study was done according to Aloui and Kenny (2005). Since Green Certification is not yet implemented, compliance cost that would be incurred in the infrastructure was studied. As per the guidelines of the Green certification, the additional cost

incurred by complying with Green Certification was mainly divided into:

a. Land, buildings and structures

b. Equipments

The data concerning the cost of the main elements were collected from three units, namely primary fish holding units, secondary fish holding units and export units.

5.2.2 Scaling the attitude of stakeholders

A generic questionnaire checklist (Canther and Kamath, 1995) was used for the preliminary identification of potential impact of the certification. The checklist was prepared based on the responses of both fish collectors, retailers, wholesalers and exporters involved in the wild caught indigenous ornamental fish trade (Cambridge *et al.*, 2011). But since the number of retailers and wholesalers involved in the wild caught indigenous business was too insignificant for the study, their responses were opted out. Ten fish collectors and ten exporters were used for the survey as per Quota sampling method (Schiffmann and Kanuk, 2001). Sixteen checklist questions were prepared for the survey, as per the guidelines of Green certification. The

respondents were asked to rank these checklists on a six point likert scale 1- not aware, 2- strongly disagree, 3- disagree, 4- neutral, 5- agree and 6- strongly disagree. Each individual's response to unfavourable statements was multiplied by -1. The responses were further analysed using the likert scale analysis (Weiers, 1984). The methodology is described in Chapter 2.

5.3 Results and Discussion

5.3.1 The probable compliance cost study

Table 15 shows the costs incurred by the primary fish holding units, secondary fish holding units and also export units with and without complying with the Green Certification guidelines. The increment investment of infrastructural facilities needed for complying with the guidelines of Green Certification is less than Rs.50000 for the three units taken for the study. The results show that the incremental costs with respect to complying with the infrastructural facilities are affordable for the stakeholders along the chain of custody. Hence this nominal cost wouldn't

be a factor to deter the stakeholders from adopting the Green Certification.

Table 15: Compliance cost with and without Green Certification

Items Existing Investment Structure (before /excluding Green Certification)	Primary Fish Holding Area *(1 Cent)*	Secondary Fish Holding Area *(15 cents)*	Export Facility *(10 Cents)*
Land, Building & Structures			
Fish Holding Area	95,810	8,98,219	5,98,813
Quarantine	-	2,69,466	1,19,763
Conditioning	-	-	1,19,763
Stores area	-	71,858	-
Office area	-	1,17,585	-
Staff area	-	53,893	47,905
Packaging area	-	89,822	59,881
Cement tanks	51,840	6,53,184	3,99,168
Glass Tanks	3,564	24,057	16,038
Borewell	-	6,500	6,500
Total for Land, Buildings & Structures	*1,51,214*	*21,84,583*	*13,67,830*
Plant & Equipments			
Generator	-	60,000	-
Air Blower	33,000	45,000	45,000
Oxygen cylinder	15,000	15,000	15,000
Nets	-	-	7,000
Hand nets	3,000	5,000	-
Filters	5,000	5,000	6,000
Motor	8,000	8,000	-
Total for Plant & Equipments	*64,000*	*1,38,000*	*73,000*
Investment Before / Without Green Certification	*2,15,214*	*23,22,583*	*14,40,830*
Cost per Year (depreciation effect)	*24,717*	*2,39,148*	*1,47,728*

Incremental Investment (Green Certification Compliance)			
Building & Structures			
Conditioning area	11,976	1,79,644	-
Packing area	11,976	-	-
Bore well	6,500	-	-
Treatment area	-	71,858	35,929
Laboratory	-	1,30,650	87,100
Office	-	-	78,390
Store	-	-	47,905
Total for Buildings & Structures	*30,453*	*3,82,151*	*2,49,324*
Plant & Equipments			
Packing machine	-	1,50,000	1,50,000
Generator	-	-	60,000
Total for Plant & Equipments	-	*1,50,000*	*2,10,000*
Incremental Investment for Green Certification	*30,453*	*5,32,151*	*4,59,324*
Cost per Year (depreciation effect)	*3,045*	*60,704*	*56,417*
Total Investment required	*2,45,667*	*28,54,734*	*19,00,154*
Cost per Year (depreciation effect)	*27,762*	*2,99,852*	*2,04,144*
Investment per Cent before /without Green Certification	2,15,214	1,54,839	1,44,083
Increment Investment per Cent for Green Certification Compliance	30,453	35,477	45,932
Total Investment required per Cent for Green certification	2,45,667	1,90,316	1,90,015

5.3.2 Scaling the attitude of stakeholders

The responses of the respondents measured on a six point likert scale are shown in Table 16. The maximum possible score for the responses for 16 checklists was 96 and minimum possible score was 16. Sixty five percent of the respondents had a positive attitude towards adopting Green Certification guidelines as their scores were above 57.

Table 16: Scaling responses using six point likert scale

RESPONDENTS	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Individual score
Fish Collectors	6	4	6	5	6	6	6	4	6	6	6	6	6	4	5	5	70
	5	3	6	5	6	6	6	6	6	6	6	6	4	4	5	5	68
	6	6	6	5	6	6	6	4	6	6	4	4	6	2	6	5	68
	6	6	6	6	4	6	4	5	6	6	5	5	6	2	6	5	67
	4	4	6	6	5	6	4	4	6	6	4	4	6	2	6	4	61
	6	6	6	6	6	6	6	6	5	5	5	5	5	2	5	5	70
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13
	4	4	4	4	5	6	4	4	6	6	6	6	6	2	4	4	59
Exporter	4	4	5	4	5	5	3	4	5	6	4	4	5	3	5	4	55
	6	3	5	4	5	6	6	6	6	6	5	2	5	3	3	3	60
	3	3	3	3	5	5	4	4	6	6	3	5	4	5	6	4	54
	4	6	6	5	6	6	5	5	6	6	3	6	6	3	6	6	70
	4	6	6	4	6	6	4	4	6	6	5	6	6	2	6	6	66
	6	6	6	3	6	6	4	4	6	6	5	6	6	2	6	4	65
	4	2	4	4	6	6	4	2	6	6	4	4	2	2	4	2	48
	4	4	6	6	6	6	4	6	6	6	6	6	6	6	6	6	72
	4	4	4	4	5	6	4	4	5	6	5	6	6	2	5	4	58
	4	4	4	4	4	5	4	4	5	6	4	4	5	2	4	4	53
	5	5	5	4	4	5	4	4	5	5	4	4	5	2	4	4	56

Most of the certification schemes are considered ambiguous, mainly due to the sceptical relationship between maintaining sustainability and profitability. Secondly, due to the lack of reliable information about the differences in tangible benefits derived from formal, certified environmental management systems (Melnyka *et al.*, 2003). In developing countries the voluntary based certification programs are gaining popularity as an alternative to costly, ineffective and seldom enforced mandatory regulations (Rivera, 2002). Many studies have been done to assess the effectiveness of voluntary certification programs (Andrews, 1998; Highley *et al.*, 2001 and Khanna, 2001) all of which have focussed on the tangible benefits as one reason to promote opting certification programs.

The compliance costs for adopting certification program greatly influences the success of the program. Aloui and Kenny (2005) had studied the cost to implement the Euregap standards in a tomato farm. The study showed that the compliance costs went up due to the addition of annually recurring costs which included training, monitoring and surveillance and certification. Maskus *et al.* (2005) have also studied the compliance cost with special reference to developing countries. The study indicated that standards do increase the short-run production costs by requiring additional inputs of labour and capital which could act as

barriers to trade. The present study has only focussed on the costs on land, buildings and equipments as the Green Certification program has not yet been launched. It has not taken into account costs for documentation and other variable costs. The main incremental variable cost involved in adopting Green Certification proposed by Marine Products Export Development Authority is the additional cost involved for keeping proper documents throughout the supply chain as prescribed by the certification system. Certification prescribes documentation in the form of log book format for

- Collection, handling and transport
- Primary holding
- Secondary holding
- Exporter's facility
- Breeding and culture facility

This system does not envisage heavy annual fees like private certification systems to protect the interest of small scale ornamental fish farmers and exporters (Silas *et al.*, 2011). This incremental recurring cost is expected to be compensated by the additional demand and better survival of the green certified ornamental fish. The relative impact of the compliance cost can be a decisive factor among stakeholders in adopting the program. Enough subsidies and public support are needed to offset the cost disadvantage.

5.4 Conclusion

Certification initiatives are frequently heralded as the most promising way to fill the regulatory vacuum created by rising globalization and declining state regulation of environmental and social relations (Raynolds *et al.,* 2007). Even after being discussed at scholary platforms, there have been few studies trying to analyse the impacts of different choice of instruments relating to environment (Cashore *et al.,* 2005). One of the major works describing the impact of certification is by Cambridge *et al.* (2011). This work focuses on the use of performance indicators in order to specifically explore the environmental impacts of Marine Stewardship Council. Despite the scarcity of scientific works and uncertainty about their actual impacts, environmental policy making opts more frequently for market-based or voluntary instruments (Bernstein, 2001).

Private regulatory initiatives can help achieve social and environmental sustainability. But they have their limitation of replacing public regulatory initiatives (Raynolds *et al.,* 2007). Amos and Claussen (2009) have identified three major components for a successful certification. They are satisfying the environmental claim, verifying chain of custody and meeting the economic incentives. Programs that provide certification for the fisheries have been blamed at

times for its generosity. Akst & Zielinska (2012) , in their report criticizes two major fisheries certification programs, the Marine Stewardship Council (MSC) and the Friend of the Sea (FOS), for certifying stocks of fish that may not be sustainable. Impact measurement is successful when the results are fast and easily understood by the consumers. Hence, the information design gathered in certification is one of the greatest potential for impact assessment (Olsen and Galimidi, 2008). Certification is not the only tool for conservation. However, under the proper management, certification can provide a set of guidelines for environmental performance and market incentives that are an important part of the larger toolbox.

CHAPTER 6

CONSUMER PREFERENCE STUDY FOR CERTIFIED FRESHWATER ORNAMENTAL FISH

6.1 Introduction

Does green consumer really exist? While some argue for green consumerism (Hawken *et al.*, 1999; Cox, 2004 and Todd, 2004) others argue that when it comes to paying that extra premium for eco-friendly products consumers really don't come forward (Vermeer *et al.*, 2010). The characteristics of a product is based on quality, safety, price, production process, taste and colour where one can evaluate the marginal value of each of these attributes to the consumer

(Pengajar, 2010). Information about the product can influence the consumer buying pattern. The information on the quality of the product is often uncertain and consumers are ambiguous to rely on these information. Market information on the quality of the product is imperfect and asymmetric with the type of products (Pengajar, 2010). Hence consumers would be willing to pay for the incentive of getting reliable information on product quality. Stigler (1961) has highlighted the importance of information, especially information on prices. There is a "search cost" attributable to time and energy expended by the consumer in finding the seller with the lowest price. Hence, the consumer's willingness to pay for information (or demand), and producers' marginal cost of providing information (or supply) has always got a market.

Ecolabelling and certification programmes are market based incentives that provide the consumers information regarding the product. It is a sort of guarantee for eco-friendliness of the product. These labels help the consumers judge the quality of the product they buy. Labeling is a means by which producers provide information to the consumers and helps in eliminating market uncertainty of finding products with credence attributes. Labels can transform

credence attributes to search attributes (Caswell, 1998) which may have an impact on the consumer behaviour.

6.2 Problems of ecolabels

Gallastegui (2002) delves into the gap between what consumers say they are willing to pay and what they really pay considering the scepticism with respect to the claims made by these environmental labels. Whether they argue for or against the existence of green consumerism, consumers buy products which satisfy their functional needs (Ottoman, 1992). Four variables in particular determine consumption practices when it comes to buying green: purchase visibility, consumption visibility, durability, and shelf-life. A product that fails to deliver the needs of the consumers fails, no matter how eco-friendly it is (Vermeer *et al.*, 2010). Mattoo and Singh (1994), in their study discuss the potential of eco-labels being detrimental to the environment. They argue that if the demand for environment- friendly product is less when compared to unfriendly goods; there is possibility that the price of environment-friendly product is less than unfriendly product, which can give producers an economic incentive to switch to environment unfriendly products. According to Gudmundsson and Wessells (2000) if a simple price

premium, that is constant, exists for fisheries irrespective of the stock size, then eco-labelling would not be sufficient to maintain the resource sustainability. Consumers' actions do not always match their stated intentions. They are generally more sensitive to factors that affect them directly, such as safety, quality and price (Washington & Ababouch, 2011).

It is difficult to assess the effectiveness and success of eco-labelling and certification programs. But studies on consumer behaviour can help in understanding the kind of policy regulations that would be necessary to enhance green consumption. Such studies can be a proxy on how much will it cost the government if regulations are to be imposed (Rencik and Hite, 2003). In this respect, consumer and producer behaviour is often used to analyze the market accessibility of eco-labeling standards (Pengajar, 2010). Geographical indication (GI) can help in increasing the demand of certified fish. Geographical indication can be defined as "a sign used on goods that have a specific geographical origin and possess qualities or a reputation that are due to that place of origin" (O' Connor, 2004). Registering under GI can help promote certified products by increasing the transparency of the product. GI gives consumers extra confidence that the product they buy are not only certified and environmentally sustainable but also has a transparency

about its origin and assures the consumers that the product has certain characteristics that are certain due to its place of origin (Silas *et al.*, 2011). Registration under GI can also act as a certification that the product contains certain qualities specific to the place of origin.

The main objective of this chapter is to find the consumer preference for probable certified freshwater wild caught fish exported from India.

6.3 Methodology

A qualitative research was carried out by developing an internet based questionnaire (Dillman, 2000) using the survey instrument kwiksurveys.org. The sample frame consisted of aquarium hobbyists identified from an aquarium fish hobbyist's forum aquaticquotient.com. Since it was difficult to identify each consumer and also due to the constraint of getting the response, convenience sampling technique was used (Schiffmann and Kanuk, 2001). The data collection was implemented by sending the questionnaires to the hobbyists via e-mail (Malhotra, 2001). Survey based responses were analysed using discrete choice analysis modifying Alencastro (2004). The technique allows the analysis of the market potential for the product or service

prior to its introduction (Bennet *et al.*, 2001). The detailed methodology is explained in section 2.7.2 of chapter 2.

6.4 Results and Discussion

Descriptive analysis showed that most of the respondents were males (55%) while females were 45%. 42% of the respondents were graduates. When compared to *Puntius denisonii*, *Tetraodon travancoricus* was the most familiar species among the hobbyists as shown in Table 17.

Table 17: Respondent familiarity with fish species used in market experiments

Fish familiarity level	*Puntius denisonii*	*Tetraodon travancoricus*
Not at all familiar	35%	30%
Somewhat familiar	37%	38%
Very familiar	28%	32%

Puntius denisonii

The initial log likelihood value obtained was 1609.991, which is a measure of a model with no independent variable, that is only constant or intercept. The final log likelihood value obtained was 0 and this is measure of a model by considering all independent variables. From the chi square

analysis it can be concluded that there is a significant relationship between dependent variable (Fish choices) and the set of independent variables (other factors) (Table 18).

Table 18: Model Fitting Information - *Puntius denisonii*

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	1609.991			
Final	.000	1609.991	51	.000

Pseudo R-Square

Cox and Snell	.937
Nagelkerke	1.000
McFadden	1.000

Table 19: Parameter estimates and regression coefficients - *Puntius denisonii*

Parameter Estimates									
Fish[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Fish F	Intercept	-269.477	39535.542	.000	1	.995			
	price	9.712	1406.911	.000	1	.994	16510.380	.000	.[b]
	cert	269.574	114790.738	.000	1	.998	1.187E+117	.000	.[b]
	MCF2MI	.000	24847.064	.000	1	1.000	1.000	.000	.[b]
	edu	.000	35518.031	.000	1	1.000	1.000	.000	.[b]
	Income1	.000	41604.404	.000	1	1.000	1.000	.000	.[b]
	Income2	.000	27980.219	.000	1	1.000	1.000	.000	.[b]
	Income3	.000	23730.706	.000	1	1.000	1.000	.000	.[b]
	Income4	0[c]	.	.	0	.	.	.	.
	Age1	.000	.000	.	1	.	1.000	1.000	1.000
	Age2	.000	26849.848	.000	1	1.000	1.000	.000	.[b]
	Age3	.000	24835.366	.000	1	1.000	1.000	.000	.[b]
	Age4	.000	20923.545	.000	1	1.000	1.000	.000	.[b]
	Age5	0[c]	.	.	0	.	.	.	.
	Q22_1	.000	27241.873	.000	1	1.000	1.000	.000	.[b]
	Q22_2	.000	36291.647	.000	1	1.000	1.000	.000	.[b]
	Q22_3	.000	34040.197	.000	1	1.000	1.000	.000	.[b]
	Q22_4	.000	30706.524	.000	1	1.000	1.000	.000	.[b]
	Q22_5	.000	31403.298	.000	1	1.000	1.000	.000	.[b]
	pricecert	-9.712	3173.479	.000	1	.998	6.057E-005	.000	.[b]

Fish H	Intercept	-146.874	49307.126	.000	1	.998			
	price	4.894	1793.157	.000	1	.998	133.433	.000	.[b]
	cert	319.340	102061.696	.000	1	.998	4.872E+138	.000	.[b]
	MCF2MI	.000	19070.283	.000	1	1.000	1.000	.000	.[b]
	edu	.000	27681.975	.000	1	1.000	1.000	.000	.[b]
	Income1	.000	32324.563	.000	1	1.000	1.000	.000	.[b]
	Income2	.000	21906.536	.000	1	1.000	1.000	.000	.[b]
	Income3	.000	18967.886	.000	1	1.000	1.000	.000	.[b]
	Income4	0[c]	.	.	0	.	.	.	.
	Age1	.000	.000	.	1	.	1.000	1.000	1.000
	Age2	.000	20345.690	.000	1	1.000	1.000	.000	.[b]
	Age3	.000	19306.879	.000	1	1.000	1.000	.000	.[b]
	Age4	.000	16305.979	.000	1	1.000	1.000	.000	.[b]
	Age5	0[c]	.	.	0	.	.	.	.
	Q22_1	.000	21730.947	.000	1	1.000	1.000	.000	.[b]
	Q22_2	.000	29874.195	.000	1	1.000	1.000	.000	.[b]
	Q22_3	.000	28713.465	.000	1	1.000	1.000	.000	.[b]
	Q22_4	.000	23603.371	.000	1	1.000	1.000	.000	.[b]
	Q22_5	.000	26760.548	.000	1	1.000	1.000	.000	.[b]
	pricecert	-9.899	3066.536	.000	1	.997	5.023E-005	.000	.[b]
Fish M	Intercept	-146.822	48344.871	.000	1	.998			
	price	4.894	1759.915	.000	1	.998	133.433	.000	.[b]
	cert	-1.936	107676.595	.000	1	1.000	.144	.000	.[b]
	MCF2MI	.000	20244.163	.000	1	1.000	1.000	.000	.[b]
	edu	.000	28847.390	.000	1	1.000	1.000	.000	.[b]
	Income1	.000	33906.967	.000	1	1.000	1.000	.000	.[b]
	Income2	.000	22450.782	.000	1	1.000	1.000	.000	.[b]

	Income3	.000	18582.756	.000	1	1.000	1.000	.000	.[b]
	Income4	0[c]	.	.	0	.	.	.	.
	Age1	.000	.000	.	1	.	1.000	1.000	1.000
	Age2	.000	22491.383	.000	1	1.000	1.000	.000	.[b]
	Age3	.000	20258.565	.000	1	1.000	1.000	.000	.[b]
	Age4	.000	16901.708	.000	1	1.000	1.000	.000	.[b]
	Age5	0[c]	.	.	0	.	.	.	.
	Q22_1	.000	21990.269	.000	1	1.000	1.000	.000	.[b]
	Q22_2	.000	28688.552	.000	1	1.000	1.000	.000	.[b]
	Q22_3	.000	26628.278	.000	1	1.000	1.000	.000	.[b]
	Q22_4	.000	25347.268	.000	1	1.000	1.000	.000	.[b]
	Q22_5	.000	24473.804	.000	1	1.000	1.000	.000	.[b]
	pricecert	.065	3094.562	.000	1	1.000	1.067	.000	.[b]
a. The reference category is: Fish J.									

Interpreting the results based on the column Exp (B) in Table 19, it can be found that the factors price and certification had a positive impact on the purchase decision of the respondents (as Exp(B) value is greater than 1). That is respondents' were willing to purchase certified fish and also willing to buy highly priced fish. But there was a negative impact on the respondent decision when highly price certified fish were the choice (as Exp(B) less than 1). This could be because highly priced fish were considered as close substitutes for certified fish indicating that highly priced fish meant better quality. Hence, respondents chose either highly priced fish or certified fish. The rest of the factors like

education, income, age, familiarity with the fish and notions for conservation didn't have any influence on the consumer decision (Exp (B) equal to 1).

Tetraodon travancoricus

The initial log likelihood value obtained was 3349.864 (model 2). The final log likelihood value obtained was 0 and this is measure of a model by considering all independent variables. From the chi square analysis it can be concluded that there is a significant relationship between dependent variable and the set of independent variables (Table 20).

Table 20: Model Fitting Information - *Tetraodon travancoricus*

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	3693.311			
Final	343.447	3349.864	154	.000

Pseudo R-Square

Cox and Snell	.966
Nagelkerke	.990
McFadden	.907

The Exp (B) values as per table 21 shows a varying influence for each factor. Price alone didn't have much role to play. It was not that important factor influencing the purchase of fish. Respondents were willing to pay for highly priced tank bred fish and certified tank bred fish, which indicates there was higher preference for tank bred fish. This could be because tank bred fish were considered close substitutes for better quality and better sustainable resource. Hence respondents were willing to accept a higher priced certified fish. The results were same even in the studies of Alencastro *et al.* (2005) which was done in certified marine ornamental fish. Deviating from the results of Alencastro (2004) respondents were also willing to pay for certified fish if they were tank bred.

Table 21: Parameter estimates and regression coefficients- *Tetraodon travancoricus*

Parameter Estimates									
Fish[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
P	Intercept	-20.638	40.058	.265	1	.606			
	Price	3.525	6.116	.332	1	.564	33.940	.000	5456591.206
	Cert	17.778	3778.052	.000	1	.996	52587555.867	.000	.[b]
	Tank	-11.071	3205.752	.000	1	.997	1.555E-005	.000	.[b]
	Familiarity	.000	19.851	.000	1	1.000	1.000	1.267E-017	78908738107690832.000
	Edu	.000	21.681	.000	1	1.000	1.000	3.507E-019	2851341084056179700.000
	Income1	.000	17.711	.000	1	1.000	1.000	8.405E-016	1189754932262580.500
	Income2	.000	11.982	.000	1	1.000	1.000	6.327E-011	15806172458.586
	Income3	.000	10.421	.000	1	1.000	1.000	1.347E-009	742121468.611
	Income4	0[c]	.	.	0	.	.	.	.
	age1	.000	22.476	.000	1	1.000	1.000	7.391E-020	13530159202368700000.000
	age2	.000	10.595	.000	1	1.000	1.000	9.592E-010	1042589536.761
	age3	.000	18.047	.000	1	1.000	1.000	4.349E-016	2299586308179456.500
	age4	.000	20.960	.000	1	1.000	1.000	1.441E-018	694135829867640190.000
	age5	.000	22.284	.000	1	1.000	1.000	1.075E-019	9299740182647908000.000
	Q22_1	.000	12.540	.000	1	1.000	1.000	2.116E-011	47248433837.903
	Q22_2	.000	12.669	.000	1	1.000	1.000	1.644E-011	60825514648.955
	Q22_3	.000	20.892	.000	1	1.000	1.000	1.648E-018	606857846603861630.000

	Q22_4	.000	10.650	.000	1	1.000	1.000	8.599E-010	1162886082.849
	Q22_5	.000	21.645	.000	1	1.000	1.000	3.764E-019	2656596826733982700.000
	PRCR	-3.525	504.391	.000	1	.994	.029	.000	.[b]
	PRTK	.327	504.045	.000	1	.999	1.387	.000	.[b]
	CRTK	11.071	569.597	.000	1	.984	64296.185	.000	.[b]
	CRTKPR	-.327	.000	.	1	.	.721	.721	.721
Q	Intercept	-1.251	84.219	.000	1	.988			
	Price	.000	12.889	.000	1	1.000	1.000	1.069E-011	93553063931.010
	Cert	.000	882.003	.000	1	1.000	1.000	.000	.[b]
	Tank	-114.400	750.905	.023	1	.879	2.074E-050	.000	.[b]
	familiarity	.000	9.792	.000	1	1.000	1.000	4.622E-009	216348496.759
	Edu	.000	10.695	.000	1	1.000	1.000	7.877E-010	1269578555.808
	Income1	.000	8.737	.000	1	1.000	1.000	3.660E-008	27324146.242
	Income2	.000	5.910	.000	1	1.000	1.000	9.312E-006	107389.483
	Income3	.000	5.141	.000	1	1.000	1.000	4.210E-005	23752.067
	Income4	0[c]	.	.	0	.	.	.	.
	age1	.000	11.087	.000	1	1.000	1.000	3.654E-010	2736828755.308
	age2	.000	5.226	.000	1	1.000	1.000	3.560E-005	28088.574
	age3	.000	8.902	.000	1	1.000	1.000	2.644E-008	37820029.320
	age4	.000	10.339	.000	1	1.000	1.000	1.581E-009	632376267.268
	age5	.000	10.993	.000	1	1.000	1.000	4.396E-010	2274701745.682
	Q22_1	.000	6.186	.000	1	1.000	1.000	5.426E-006	184310.584

	Q22_2	.000	6.250	.000	1	1.000	1.000	4.790E-006	208767.648
	Q22_3	.000	10.306	.000	1	1.000	1.000	1.690E-009	591818444.471
	Q22_4	.000	5.254	.000	1	1.000	1.000	3.373E-005	29643.078
	Q22_5	.000	10.677	.000	1	1.000	1.000	8.156E-010	1226038264.258
	PRCR	.000	117.721	.000	1	1.000	1.000	6.243E-101	1.602E+100
	PRTK	17.303	118.026	.021	1	.883	32704692.322	1.123E-093	9.521E+107
	CRTK	114.400	133.314	.736	1	.391	4.821E+049	1.606E-064	1.447E+163
	CRTKPR	-17.303	.000	.	1	.	3.058E-008	3.058E-008	3.058E-008
U	Intercept	8.885	39.778	.050	1	.823			
	Price	-.355	6.088	.003	1	.953	.701	4.612E-006	106570.360
	Cert	-9.450	1460.718	.000	1	.995	7.865E-005	.000	.[b]
	Tank	-38.300	1239.977	.001	1	.975	2.326E-017	.000	.[b]
	familiarity	.000	7.675	.000	1	1.000	1.000	2.931E-007	3411499.010
	Edu	.000	8.383	.000	1	1.000	1.000	7.323E-008	13654831.181
	Income1	.000	6.848	.000	1	1.000	1.000	1.484E-006	673958.039
	Income2	.000	4.632	.000	1	1.000	1.000	.000	8773.609
	Income3	.000	4.029	.000	1	1.000	1.000	.000	2689.038
	Income4	0[c]	.	.	0	.	.	.	.
	age1	.000	8.690	.000	1	1.000	1.000	4.011E-008	24931402.371
	age2	.000	4.096	.000	1	1.000	1.000	.000	3066.750
	age3	.000	6.978	.000	1	1.000	1.000	1.150E-006	869527.885
	age4	.000	8.104	.000	1	1.000	1.000	1.265E-007	7907660.064

	age5	.000	8.616	.000	1	1.000	1.000	4.637E-008	21567054.819
	Q22_1	.000	4.848	.000	1	1.000	1.000	7.464E-005	13398.142
	Q22_2	.000	4.898	.000	1	1.000	1.000	6.769E-005	14772.613
	Q22_3	.000	8.077	.000	1	1.000	1.000	1.332E-007	7507324.720
	Q22_4	.000	4.118	.000	1	1.000	1.000	.000	3198.997
	Q22_5	.000	8.369	.000	1	1.000	1.000	7.526E-008	13286410.980
	PRCR	.355	195.012	.000	1	.999	1.426	1.443E-166	1.410E+166
	PRTK	4.207	194.959	.000	1	.983	67.148	7.543E-165	5.978E+167
	CRTK	38.300	220.305	.030	1	.862	42989864207369176.000	1.287E-171	1.436E+204
	CRTKPR	-4.207	.000	.	1	.	.015	.015	.015
N	Intercept	-.004	56.256	.000	1	1.000			
	Price	.000	8.609	.000	1	1.000	1.000	4.695E-008	21300570.189
	Cert	.000	1244.875	.000	1	1.000	1.000	.000	.[b]
	Tank	-28.849	1057.714	.001	1	.978	2.958E-013	.000	.[b]
	familiarity	.000	5.318	.000	1	1.000	1.000	2.974E-005	33623.087
	Edu	.000	5.204	.000	1	1.000	1.000	3.720E-005	26883.311
	Income1	.000	4.267	.000	1	1.000	1.000	.000	4284.774
	Income2	.000	2.840	.000	1	1.000	1.000	.004	261.705
	Income3	.000	2.482	.000	1	1.000	1.000	.008	129.683
	Income4	0[c]	.	.	0	.	.	.	.
	age1	.000	5.358	.000	1	1.000	1.000	2.747E-005	36403.209
	age2	.000	2.539	.000	1	1.000	1.000	.007	144.817

	age3	.000	4.294	.000	1	1.000	1.000	.000	4523.253
	age4	.000	4.989	.000	1	1.000	1.000	5.670E-005	17635.277
	age5	.000	5.290	.000	1	1.000	1.000	3.144E-005	31803.354
	Q22_1	.000	3.140	.000	1	1.000	1.000	.002	470.767
	Q22_2	.000	3.022	.000	1	1.000	1.000	.003	373.836
	Q22_3	.000	5.209	.000	1	1.000	1.000	3.679E-005	27181.092
	Q22_4	.000	2.534	.000	1	1.000	1.000	.007	143.615
	Q22_5	.000	5.330	.000	1	1.000	1.000	2.906E-005	34414.683
	PRCR	.000	166.197	.000	1	1.000	1.000	3.412E-142	2.931E+141
	PRTK	3.852	166.294	.001	1	.982	47.073	1.326E-140	1.671E+143
	CRTK	62.457	187.894	.110	1	.740	133208984034488060000000000.00	1.544E-133	1.149E+187
	CRTKPR	-7.755	.000	.	1	.	.000	.000	.000
G	Intercept	-.295	60.825	.000	1	.996			
	Price	.000	9.309	.000	1	1.000	1.000	1.193E-008	83852730.406
	Cert	44.942	1345.983	.001	1	.973	3297586790824981000 0.000	.000	.[b]
	Tank	-28.849	1143.610	.001	1	.980	2.958E-013	.000	.[b]
	familiarity	.000	5.220	.000	1	1.000	1.000	3.605E-005	27735.493
	Edu	.000	6.196	.000	1	1.000	1.000	5.321E-006	187931.012
	Income1	.000	5.208	.000	1	1.000	1.000	3.688E-005	27113.028
	Income2	.000	3.596	.000	1	1.000	1.000	.001	1150.358
	Income3	.000	3.019	.000	1	1.000	1.000	.003	371.552
	Income4	0[c]	.	.	0	.	.	.	.

	age1	.000	6.578	.000	1	1.000	1.000	2.515E-006	397593.081
	age2	.000	3.017	.000	1	1.000	1.000	.003	369.582
	age3	.000	5.375	.000	1	1.000	1.000	2.660E-005	37590.632
	age4	.000	6.234	.000	1	1.000	1.000	4.943E-006	202303.008
	age5	.000	6.717	.000	1	1.000	1.000	1.916E-006	521821.051
	Q22_1	.000	3.354	.000	1	1.000	1.000	.001	715.797
	Q22_2	.000	3.701	.000	1	1.000	1.000	.001	1414.419
	Q22_3	.000	5.932	.000	1	1.000	1.000	8.934E-006	111936.254
	Q22_4	.000	3.126	.000	1	1.000	1.000	.002	458.016
	Q22_5	.000	6.090	.000	1	1.000	1.000	6.554E-006	152574.299
	PRCR	-5.220	179.694	.001	1	.977	.005	5.985E-156	4.888E+150
	PRTK	3.852	179.799	.000	1	.983	47.073	4.241E-152	5.224E+154
	CRTK	-16.093	203.148	.006	1	.937	1.025E-007	1.232E-180	8.534E+165
	CRTKPR	1.368	.000	.	1	.	3.928	3.928	3.928
R	Intercept	-1.618	97.691	.000	1	.987			
	Price	.000	14.951	.000	1	1.000	1.000	1.879E-013	5321306425945.723
	Cert	-146.828	12775.401	.000	1	.991	1.712E-064	.000	.[b]
	Tank	-28.849	1837.685	.000	1	.987	2.958E-013	.000	.[b]
	familiarity	.000	11.359	.000	1	1.000	1.000	2.146E-010	4660675325.940
	Edu	.000	12.406	.000	1	1.000	1.000	2.755E-011	36298199052.711
	Income1	.000	10.134	.000	1	1.000	1.000	2.365E-009	422767448.396
	Income2	.000	6.856	.000	1	1.000	1.000	1.460E-006	685043.471

	Income3	.000	5.963	.000	1	1.000	1.000	8.402E-006	119025.849
	Income4	0[c]	.	.	0	.	.	.	.
	age1	.000	12.860	.000	1	1.000	1.000	1.130E-011	88478767277.902
	age2	.000	6.062	.000	1	1.000	1.000	6.916E-006	144584.345
	age3	.000	10.326	.000	1	1.000	1.000	1.622E-009	616397312.760
	age4	.000	11.993	.000	1	1.000	1.000	6.183E-011	16172823515.317
	age5	.000	12.751	.000	1	1.000	1.000	1.401E-011	71394577884.164
	Q22_1	.000	7.176	.000	1	1.000	1.000	7.801E-007	1281831.021
	Q22_2	.000	7.249	.000	1	1.000	1.000	6.751E-007	1481156.961
	Q22_3	.000	11.954	.000	1	1.000	1.000	6.677E-011	14975732168.129
	Q22_4	.000	6.094	.000	1	1.000	1.000	6.497E-006	153906.350
	Q22_5	.000	12.385	.000	1	1.000	1.000	2.869E-011	34857557142.156
	PRCR	19.603	1705.671	.000	1	.991	326250028.242	.000	[b] .
	PRTK	3.852	288.922	.000	1	.989	47.073	5.522E-245	4.012E+247
	CRTK	175.677	12868.085	.000	1	.989	1.975E+076	.000	[b] .
	CRTKPR	-23.455	1723.880	.000	1	.989	6.511E-011	.000	[b] .
S	Intercept	-.689	68.723	.000	1	.992			
	Price	.000	10.517	.000	1	1.000	1.000	1.116E-009	896149401.257
	Cert	.000	1520.032	.000	1	1.000	1.000	.000	[b] .
	Tank	-28.849	1292.108	.000	1	.982	2.958E-013	.000	[b] .
	familiarity	.000	7.310	.000	1	1.000	1.000	6.000E-007	1666771.361
	Edu	.000	8.375	.000	1	1.000	1.000	7.428E-008	13462447.883

	Income1	.000	6.819	.000	1	1.000	1.000	1.568E-006	637739.323
	Income2	.000	4.691	.000	1	1.000	1.000	.000	9837.075
	Income3	.000	4.055	.000	1	1.000	1.000	.000	2828.118
	Income4	0[c]	.	.	0	.	.	.	.
	age1	.000	8.787	.000	1	1.000	1.000	3.313E-008	30186117.373
	age2	.000	4.223	.000	1	1.000	1.000	.000	3934.214
	age3	.000	6.960	.000	1	1.000	1.000	1.190E-006	840311.790
	age4	.000	8.109	.000	1	1.000	1.000	1.253E-007	7981688.682
	age5	.000	8.633	.000	1	1.000	1.000	4.484E-008	22299219.450
	Q22_1	.000	4.742	.000	1	1.000	1.000	9.189E-005	10882.740
	Q22_2	.000	5.012	.000	1	1.000	1.000	5.419E-005	18453.397
	Q22_3	.000	7.457	.000	1	1.000	1.000	4.498E-007	2223375.906
	Q22_4	.000	4.172	.000	1	1.000	1.000	.000	3556.066
	Q22_5	.000	8.342	.000	1	1.000	1.000	7.924E-008	12620215.604
	PRCR	.000	202.928	.000	1	1.000	1.000	1.850E-173	5.406E+172
	PRTK	3.852	203.146	.000	1	.985	47.073	5.682E-172	3.900E+174
	CRTK	-29.109	229.534	.016	1	.899	2.281E-013	9.519E-209	5.465E+182
	CRTKPR	3.886	.000	.	1	.	48.735	48.735	48.735
a. The reference category is: T.									

CV techniques are an important tool in assessing the attitude of consumers towards a new commodity especially when there is a change in the quality of the product. But due consideration should be given to the differences between theoretical and empirical background in such cases (Corsi, 2007). Most of the literature dealing with consumers' WTP studies has not mentioned about the quantity of the product available with the given price premiums (Ott, 1990; Weaver *et al.*, 1992; Thompson and Kidwell, 1998 and Wessels *et al.*, 1999). The present study has mentioned silently the quantity of fish that would be obtained for the given price. Janssen and Hamm (2011) have identified that factors like consumer awareness, perception and attitude towards organic products influence the consumer WTP. In the present study, respondents are well aware of the sustainability issues in the ornamental fish industry, which is clear from Tables 22a-22e and they hope that certification can help in maintaining environmental sustainability.

Tables 22a: Respondent opinion about the impact of certification

Prevents unnecessary mortality during collection and transport

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all compelling	14	14.0	14.0	14.0
	Has no influence on decision	35	35.0	35.0	49.0
	Very compelling	51	51.0	51.0	100.0
	Total	100	100.0	100.0	

Tables 22b: Respondent opinion about the impact of certification

Prevents damage to the riverine habitat during collection

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all compelling	14	14.0	14.0	14.0
	Has no influence on decision	23	23.0	23.0	37.0
	Very compelling	63	63.0	63.0	100.0
	Total	100	100.0	100.0	

Table 22c: Respondent opinion about the impact of certification

Prevents over fishing of specific species

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all compelling	9	9.0	9.0	9.0
	Has no influence on decision	21	21.0	21.0	30.0
	Very compelling	70	70.0	70.0	100.0
	Total	100	100.0	100.0	

Table 22d: Respondent opinion about the impact of certification

Specimens are healthier than uncertified specimens

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all compelling	6	6.0	6.0	6.0
	Has no influence on decision	14	14.0	14.0	20.0
	Very compelling	80	80.0	80.0	100.0
	Total	100	100.0	100.0	

Table 22e: Respondent opinion about the impact of certification

The certification programme will enhance the protection and preservation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all compelling	7	7.0	7.0	7.0
	Has no influence on decision	26	26.0	26.0	33.0
	Very compelling	67	67.0	67.0	100.0
	Total	100	100.0	100.0	

6.5 CONCLUSION

Though most of the studies show that consumers are willing to pay higher price premiums for certified products, the situation may not be same when it comes to really paying higher prices. In a study conducted in 1991, Green Seal reported that four out of five consumers said that they would choose a product with the Green Seal logo over a product without it, quality and price being equal (EPA 1994). This was just the stated willingness to purchase and no later studies were

conducted to gauge actual consumer awareness or behaviour who agrees to buy certified "green" products through its Environmental Partners program. Freriks (2012) has mentioned that products perceived with a lower level of risk including lower risk to humans are having lower WTP statistically when compared to products of greater functional risk. Ornamental fishes do belong to the first group where consumers do not have any immediate risk of buying wild caught or environmentally degraded fishes. So in this case, attitude and perception of consumers should be changed from just a hobby to a revelation that the hobby can change the balance of the environment.

Malthouse (2009) in the survey on the broad perspectives on the eco-labels and certification, points out that government support of a labelling program can increase the credibility, recognition, financial stability, legal protection and long term viability. This is mainly because the private programs have not yet satisfactorily established their credibility and long-term viability, making larger corporations reluctant to join (Paulose, 1998).

The results of this work may not be able to apply to the entire population as the sample size is small and

the study has adopted convenient sampling technique. The work can be viewed as a pilot study to understand the preferences of hobbyists, which could be useful in increasing demand for certified freshwater ornamental fish.

CHAPTER 7

SUMMARY OF THE FINDINGS AND CONCLUSIONS

7.1 Introduction

A very small sector when compared to food fish sector, the ornamental fish sector has its own importance in the global trade map. The ornamental fish trade of India never shares a prestigious volume in the trade like the total marine food fish products. Even being in an unenviable position, ornamental fish industry poses sustainability threats. The study is an attempt to identify the sustainability issues and tries to evaluate the role; freshwater ornamental fish certification can play engendering sustainability. The

following sections will give the summary of the results confined in the previous chapters.

7.2 Summary of Results

Chapter 1 introduces early conservation efforts and the concept of sustainability and market based incentives and connects it to fisheries and ornamental fish trade. The relevance and scope of the work is also discussed. The chapter also contains reviews about different approaches taken to maintain the conservation efforts in the ornamental fish sector concentrating especially on certification. The section also reviews the impact of eco labels and certification on different certified products and tries to measure the consumer preference of the certified products. The review highlights the fact that though there are many conservation efforts in ornamental fish trade like DNA bar coding to identify the species, different quarantine techniques, different agreements and legislations, the concept of certification illustrates a formal guideline that can be implemented in the global ornamental fish trade. While discussing the consumer preference for certified products, it can be noted that consumers do give importance to certifications that highlight food safety. Hence the acceptance of certified ornamental

fish species, which have no impact on human health, is questionable.

Chapter 2 describes the research methodology adopted for the study.

Chapter 3 gives an overview of the export trend by calculating the annual growth and compounded annual growth. The efficiency of the exporting firms is also looked into in this chapter. Also, a list of ornamental fish species exported from India is given here. 287 native fish species, 92 exotic fish species and 45 ornamental shrimps were found to be exported from India as ornamental fish. Exporting firms with high capital investment exported more quantity of fish from India. High capital investment led to a decline of labour and other miscellaneous costs. The export trend showed a decline after 2007-2008. Many reasons could be associated with this decline. The great economic recession, the decline in the demand for indigenous fish from India due to captive breeding of much hyped fish indigenous to India, A dip in the exports of Singapore, Thailand and Malaysia in 2008 can all be seen as the reasons for the decline in the exports. This declining trend is clearly visible from the position of India in the global ornamental fish trade which showed a downward movement from 24th position in 2004.

Chapter 4 tries to connect the concept of sustainability to the Indian ornamental fish industry. The chapter has focussed on the major sustainability issues along the chain of custody, tried to link the sustainability criteria and indicators of wild caught ornamental fish industry and also has also looked into the sustainability assessment of the three major exported indigenous ornamental fish species from India. It has also tried to analyse the effectiveness of the Kerala government order which was released to conserve *Puntius denisonii*. Poor quality of water was identified by the stakeholders as the major sustainability issue threatening the quality of ornamental fish exported from India. By linking the sustainability indicators through cognitive mapping, quantity of catch was found central of sustainability issues for the wild caught indigenous ornamental fish exported from India. When sustainable issues are debated on one side, on the other side there is no baseline information on *Tetraodon travancoricus* assessed as vulnerable, *Dario dario* assessed as data deficient and *Puntius denisonii* assessed as endangered (IUCN, 2012) which are also the three most exported indigenous wild caught ornamental fishes of India. When quality of fish degrades, it leads to higher DOA that prompts the catching of more fish. Hence, quality of fish should be maintained at each stage of chain of custody that

will reduce the DOA and enhances the sustainability of the resources. To maintain quality of fish resources it is important to have the basic information of the regarding its cycle, breeding season, fish biology, stock assessment, and management measures etc. The government notification for conserving *Puntius denisonii* also had many flaws. Without thinking much about the distribution of the species the notification was released.

Chapter 5 analyses the impact of probable introduction of Green Certification and the impact has been analysed within two perspectives. One was with in the framework of studying the compliance cost while introducing the certification and second one was to measure the stakeholder attitude towards certification scheme promoting resource sustainability. The increment investment needed for complying with the guidelines of Green Certification is less than Rs.50000 for the three units taken for the study. The results show that the incremental costs are affordable for the stakeholders along the chain of custody. The measurement of stakeholder attitude showed that 65% of the respondents had a positive attitude towards adopting Green Certification guidelines. Since complying with certification standards with respect to infrastructure does not require high investment,

giving proper awareness to the stakeholders can enable better implementation of the scheme.

Chapter 6 has concentrated on analysing the consumer preference of certified freshwater fish. The results from the study show that respondents were willing to buy either certified fish or highly priced fish in the case of *Puntius denisonii*, whereas in the case of *Tetraodon travancoricus* , preference was for highly priced tank bred fishes and certified fish tank bred fish. The first result showed that respondents considered high price as a close substitutes for high quality fish and in the second scenario tank bred fish was considered close substitutes for high quality fish. It can be interpreted that consumers do understand that certified fish or rather so called 'high quality' labelled fish will fetch high price that they are willing to pay. But scepticism remains regarding whether consumers will actually pay high price for certified fish in real situation. However, better survival, good perception among consumers, healthy fish and higher demand would be an added attraction for certified fish.

7.3 Recommendations

Certification is not the ultimate word for conservation. But the tool has an advantage of being a market based

incentive besides developing standards for ensuring environmental standards. The program is also a boon for serious hobbyists who want to know the details of their pet fish like source of collection, the time of collection, water parameters at the time of collection the breed etc. The study has tried to find the sustainability issues in the wild caught ornamental fish industry and has tried to analyse whether certification can be an effective tool. With respect to the work conducted the following challenges have been found with respect to implementing certification and possible solutions have been recommended (Table 23). Although limited, and still being tested, these reforms suggest opportunities for improvements in the future.

Table 23: Challenges and possible solutions in implementing certification

Challenges	Possible Solutions
Fish collectors are the major link to the sustainability of the resources. Major awareness should be done at the fish collector stage.	For this an organization or a society for ornamental fish collector would be the best solution. The organization will also ensure that whether the collectors are paid reasonably and also help in implementing certification.
The biggest challenge in implementing certification is the ambiguity that whether price premium trickles down to the lower most stage of chain of custody which is the fish collector stage	Hence government should fix a specific support price for the fishermen which will encourage them to adopt conservation efforts.
Green Certification is a voluntary certification scheme, there can be exporters who will not undertake the scheme and hence export uncertified fish at a lower rate compared to certified fish.	There should be a guarantee between importers and exporters that only certified fish will be traded and bought. This can be implemented if policies are made at government levels and agreed by government of importing countries too. Only certified units shall be offered subsidy and grant from Marine Products Development Authority and other agencies to motivate more accepting certification system
Responsible players in the industry adhere to good management practices, ensuring better quality and practices along the chain of custody without a certification scheme	One or two players being responsible in the industry cannot bring in conservation efforts at all stages. Hence a unified guideline should be there to regulate the whole industry.

Other possible recommendations are:

- New export licences should be issued only if exporters adopt and stick to the certification schemes.
- Wild caught indigenous fish should be stringently certified. Since exporters exporting wild caught fish are comparatively less, implementation and monitoring will be easy.
- Licenses should be given to ornamental fish collectors.
- Harmonization codes should be developed for each species exported which will help in tracking the species and quantity exported.
- A quota for export should be introduced, according to which the total exports of an exporter, at a time, can include only a specific percentage of the wild caught indigenous fish. There will be no quota for certified indigenous fish.
- End seller is important than the buyer. Hence increasing awareness of the scheme, logo, and its relevance should be communicated even among the stakeholders at the importing country.
- Strategies like stealth marketing can be utilized for marketing certified fish.
- Tax relaxation can be given to exporters exporting certified fish.

- Campaigns should be directed in such a way by identifying the message that works.
- Along with environmental message, equal importance should be projected towards the economic benefits that could be achieved through certification.
- More scientific studies should be conducted on the environmental and socio-economic benefits of certification and also there should be support from both scientific and non-scientific community associated with the industry.

7.4 Conclusion

CEC (1999) highlights three fates for ecolabels introduced in market. They are

- Market Standard: Ecolabel is widely accepted and becomes standard in the marketplace
- Market Niche: Ecolabel is viable, but not as widely accepted.
- Failure: Ecolabel is not accepted by consumers and fails

Eco-labels that were developed in response to consumer demand and those that certify a large number of producers were found to be more successful (Searle *et al.*, 2004). The work also suggests that the program should begin

in a "soft" mode and the rigor be increased overtime to ensure validity among consumers. Unlike a common foundation in natural science which is the basis for environmental science, there is no common foundation on which social metrics can be built (Figge *et al.*, 2002). This is the reason why the integration of the three dimensions of sustainability and social metrics are rare. In addition there is also varied nature of social aspects of interest (Seuring and Muller, 2008).

Implementing certification in marine ornamental sector would require substantial changes. But implementing certification in freshwater ornamental fish sector, at least in India which has an insignificant position in global exports of ornamental fish, would not be a hard nut to crack. Chatterji and Levine (2006) points out the fact that what labeling organizations must do is make a greater effort to communicate relevant information, rather than simply more information to consumers at the point of sale. It is the responsibility of a country to conserve its resources and hence conservation cannot be taken for granted, but it must be strictly implemented.

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Annexure

Questionnaires

1. Chain of Custody

EXPORTERS

Name of the person

Address, Name of the exporting company

Email

Are you a full time exporter? YES/NO

If No, what is your profession?

Do you have exports to domestic markets?

If Yes, states you export

Countries to which you export

Do the states or countries place order for specific species and specific number?

If yes, based on what factors do they place the orders

- Demand by consumers
- Price
- Wild caught/ Bred
- Others

If no, what are the criteria of exporting specific species in specific numbers?

Which do you export?

- Wild caught fish
- Farmed fish
- Both

If both, ratio of wild caught to farmed fish or percentage of wild caught fish and farmed fish.

Which is the most sought after wild caught fish in the domestic market?

Most sought after wild caught fish in the international market?

Among cultured species, which is the most sought after fish in the domestic market?

Among cultured species, which is the most sought after fish in the international market?

From whom do you collect fish

- Fishermen

- Intermediaries- breeder, middlemen, wholesalers, retailers
- Collect fish directly

Places you collect wild caught fish from?

Places you collect farmed fish from?

Mode of transport to exporting unit

Mode of packing when transported to exporting company

- Packing
- Amount of oxygen
- Packing density
- Anaesthetics or tranquilizers

Percentage or number of mortality of fish species when it reaches the exporting unit

Reasons for mortality you consider

- Stress during transportation
- Method of catching fish
- High packing density
- Depleted oxygen
- Water quality
- Others

Which species exhibits maximum mortality? Reasons?

- Number of days you hold fish before exporting
- During holding
- Type of feeds given

- Tests done any to check diseases
- Diseases usually encountered
- Any antibiotics given
- Mortality rate, if any

Quarantine measures given before exporting

Tests that mist be done before exports

Tests being done in your company before exports

Packaging methods for exports

Method of transportation to domestic markets

DOA claim at destination, if any

Do you export marine species?

If yes,

Species

Source

Is there any certification procedure followed?

Do you follow any guidelines to export fish to foreign destinations?

Will you support a certification program ?

According to you what are the potential positive and negative impacts if any?

Issues that you feel is a threat to the business

Problems you face to sustain in the industry

FISHERMAN

Name

Address

Are you a full time fisherman of ornamental fish

Source of fish collection

Gears used

What are the different types of methods usually adopted to catch fish

Kind of crafts used

What are the facilities carried in the boat taken for fish collection

Species of fish caught

Time of catching fish

Any specific season for particular species

Seasons when there is maximum fishing

Mortality, if any, while transporting fish to holding units

Precautions taken to avoid mortality while transportation

First thing done after the fish is brought to the shore to the holding units

Any quarantine measure given

Any medication given

Tests done, if any, to detect diseases

Diseases usually seen

To whom all do you sell fish

- Exporters
- Retailers

- Wholesalers
- Direct selling to customers
- Is there any exports

Do you catch fish based on any specific orders given?

Facilities in the holding units

Water facility

How many days prior quarantine will be given once an order is placed?

Packing method

Any anaesthetics/tranquilizers given?

Ratio of water to oxygen for packing

Stocking density

Kind of packing

Mode of transportation

Have you heard of any guidelines for catching ornamental fish

Have you heard of the concept of certification?

Will you support a certification program?

According to you what are the potential positive and negative impacts if any?

Issues that you feel is a threat to the business

Problems you face to sustain in the industry

Generic Checklist Questionnaire

Reduction in the catch of non-target species and juveniles

Less by-catch

Less mortatlity

Less habitat destruction

Better health condition of the fish caught

Better sanitary measures and BMP in holding and export units

Better stock rebuilding

Conservation of ETP

Greater capital investment

Displacement of small-scale stakeholders

Lesser DOA

Better quality and less stress of the fish

Better price premium

Price premium trickling down to lowel level stakeholders

Better competitive advantage

Enhancing environmental sustainability

2. Compliance Costing

Name of the stakeholder

Address

Which part of the chain of custody do they belong?

Kind of unit

- Primary fish holding unit

- Secondary fish holding unit
- Export unit

How much cents of land do you possess?

Own land/rented land

No: of cement tanks/fibre tanks

No: of glass tanks

Stocking density of fish in each tank:

Infrastructure facilities available:

Cost of each infrastructure facility:

Kind of water supply:

Electricity charges:

Compliance costs of buildings, infrastructures:

Aquarium tanks:

Concrete tanks:

Well:

Buildings:

Office:

Store area:

Staff area:

Packaging area:

Aerator:

Tube, stones:

Hose:

Pump:

Generator:

Oxygen cylinder:

Generator:

Feeds:

Transportation costs:

Nets:

3. Discrete Choice Analysis

1) Name and contact details (Name, address, country, state n email)

2) Gender

(2 a) Age

a) Below 20 years

b) 20-30 years

c) 30-40 years

d) 40-50 years

e) Above 50 years

3) What is the highest level of education that you have completed

a) Less than high school

b) High school

c) Graduate

d) PG

e) Others

4) In what range is your total household income?

a) Less than 25000 USD

b) USD 25001 to USD 50000

c) USD 50001 to 75000

d) Above USD 75000

5) How familiar are you with the two species

Species	Not at all familiar	Somewhat familiar	Very familiar
Puntius denisonii			
Tetraodon travancoricus			

6) You have decided to purchase a medium sized *Puntius denisonii* today. When you go to buy fish you find you have a choice between two at a given time. Both have been collected from the wild in India and they appear to be identical. Given what you know about this species and the industry, which would you choose? (*Puntius denisonii*-choice 1)

Fish F-$29.99 wild caught from India not certified 1 year live guarantee

Fish J-$25.49 wild caught from India not certified 6 months live guarantee

7) Puntius denisonii- Choice 2 (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish J-$25.49 wild caught from India not certified 6 months live guarantee

Fish H--$29.99 wild caught from India certified 6 months live guarantee

8) Puntius denisonii – Choice 3 at a given time ((*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish H--$29.99 wild caught from India certified 6 months live guarantee

Fish F--$29.99 wild caught from India not certified 1 year live guarantee

9) Puntius denisonii – Choice 4 at a given time ((*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish M—$34.48 wild caught from India certified 1 year live guarantee

Fish J--$25.49 wild caught from India not certified 6 months live guarantee

10) Puntius denisonii – Choice 5 at a given time ((*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish H--$29.99 wild caught from India certified 6 months live guarantee

Fish M--$34.48 wild caught from India certified 1 year live guarantee

11) Puntius denisonii – Choice 6 at a given time (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish M--$34.48 wild caught from India certified 1 year live guarantee

Fish F--$29.99 wild caught from India not certified 1 year live guarantee

12) You have decided to purchase a small (approx. Half inch) dwarf puffer today. . When you go to buy fish you find you have a choice between two at a given time. Both are offered with 1year live guarantee and they appear to be identical. Given what you know about the species which choice would you choose? Dwarf Puffer- Choice 1

Fish P-$7.49 wild caught from India not certified 6 months live guarantee

Fish T-$6.36 tank bred not certified 6 months live guarantee

13) Dwarf Puffer- Choice 2 (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish Q-$7.49 tank bred not certified 1 year live guarantee

Fish U-$6.36 wild caught from India not certified 1 year live guarantee

14) Dwarf Puffer- Choice 3 (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish T-$6.36 tank bred not certified 1 year live guarantee

Fish N-$7.49 tank bred certified 1 year live guarantee

15) Dwarf Puffer- Choice 4 (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish N-$7.49 tank bred certified 1 year live guarantee

Fish P-$7.49 wild caught from India not certified 1 year live guarantee

16) Dwarf Puffer- Choice 5 (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish G-$7.49 wild caught from India certified 1 year live guarantee

Fish Q-$7.49 tank bred not certified 1 year live guarantee

17) Dwarf Puffer- Choice 6 (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish R-$8.61 wild caught from India certified 1 year live guarantee

Fish T-$6.36 tank bred not certified 1 year live guarantee

18) Dwarf Puffer- Choice 7 (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish S-$8.61 tank bred certified 1 year live guarantee

Fish U-$6.36 wild caught from India not certified 1 year live guarantee

19) Dwarf Puffer- Choice 8 (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish N-$7.49 tank bred certified 1 year live guarantee

Fish R-$8.61 wild caught from India certified 1 year live guarantee

20) Dwarf Puffer- Choice 9 (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish G-$7.49 wild caught from India certified 1 year live guarantee

Fish S-$8.61 tank bred certified 1 year live guarantee

21) Dwarf Puffer- Choice 10 (*Note: Please consider each choice independently. Do not try to recall the past choices or anticipate future choices*)

Fish R-$8.61 wild caught from India certified 1 year live guarantee

Fish P-$7.49 wild caught from India certified 1 year live guarantee

22)In your opinion how compelling are each of the following reasons for purchasing wild caught certified (environmental friendly) specimens?

	Not at all compelling	Has no influence on decision	Very compelling
Prevents unnecessary mortality during collection and transport as compared to uncertified specimens			
Prevents damage to the riverine habitat during collection as compared to uncertified specimens			
Prevents over fishing of specific species			
Specimens are healthier than uncertified specimens			
The certification programme will enhance the protection and preservation of habitats in the wild			

Appendix

Research articles published

International Refereed Publications

- Jayalal, L. and Ramachandran. (2013) A. Linking Sustainability Indicators of Indian Indigenous Wild Caught Ornamental Fish Industry, International Journal of Environmental Sciences, Vol.3, No.6, 1891- 1898 .
- Jayalal, L. and Ramachandran A. (2012) Export Trend of Indian Ornamental Fish Industry, Agriculture and Biology Jl. of North America, Vol. 3 No. 11, 439-451. (Impact Factor 0.940) 2011

National Refereed Publications

Jayalal, L. and Ramachandran A. (2013). Major Sustainability Issues and Comparative Sustainability Assessment of Wild Caught Indigenous Ornamental Fishes Exported from Kerala, India,Fishery Technology, 50 (2).(NASS Rating:4.10) ISBN : 0015 3001