STUDIES ON SUPPLY CHAIN PERFORMANCE, RISK AND SUSTAINABILITY: A CASE OF ORNAMENTAL FISH SUPPLY CHAIN

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By

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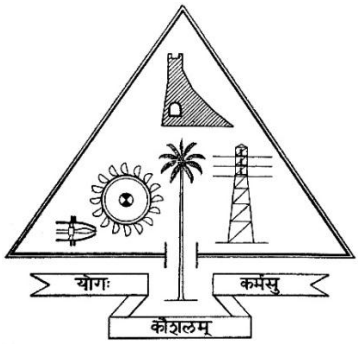

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CERTIFICATE

This is to certify that the work reported in this thesis entitled "**Studies on Performance, Risk and Sustainability: A Case of Ornamental Fish Supply Chain"** that is being submitted by **Mr. MOHAMMED IQBAL C.**for the award of the Degree of Doctor of Philosophy, to the University of Calicut, is based on the bonafide research work carried out by him under my supervision and guidance in the Department of Mechanical Engineering, Government Engineering College, Thrissur, University of Calicut. The results embodied in this thesis have not been included in any other thesis submitted previously for the award of any degree or diploma of any other University or Institution.

Thrissur – 9 **Dr.SHALIJ P.R.**
3rd September 2018-09-03 (Supervising Teacher)

DECLARATION

I hereby declare that this thesis entitled **STUDIES ON SUPPLY CHAIN PERFORMANCE, RISK AND SUSTAINABILITY: A CASE OF ORNAMENTAL FISH SUPPLY CHAIN** submitted to the University of Calicut, for the award of Degree of Doctor of Philosophy under the Faculty of Engineering is an independent work done by me under the supervision and guidance of Dr.SHALIJ P.R; Associate Professor, Department of Production Engineering, Government Engineering College Thrissur, University of Calicut.

I also declare that this thesis contains no material which has been accepted for the award of any other degree or diploma of any University or Institution and to the best of my knowledge and belief, it contains no material previously published by any other person, except where due references are made in the text of the thesis.

MOHAMMED IQBAL C.

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Thrissur – 9 **MOHAMMED IQBAL C.**

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ABBREVIATIONS

SCM	Supply Chain Management
ANOVA	Analysis of Variance
MPEDA	Marine product Export Development Authority
KMO	Kaiser Meyer Olkin
WTO	World Trade Organization
SCOR	Supply Chain operation and Reference Model
BSC	Balanced Score Card
TBL	Triple Bottom Line
ITES	Information technology Enabled Services
TQM	Total quality Management
MPEPC	Marine product export promotion council
SME	Small Scale industries
SPSS	Statistical package for the Social science
IIFT	Institute of Foreign Trade

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Aquarium fish keeping had been one of the major hobbies, mainly of the elite and privileged sections of the society in the developed world (Alava and Gomes 1989). However in the recent times, it has become the second largest hobby of the world next to the photography. In the modern world, people keep live fish due to several reasons. Live fish is believed to bring luck according to vasthu and Feng-Sui - as the beliefs and regional customs. Children and aged people are keeping ornamental fishes for enjoyment, companion or as a pet animal. Spread of customs and believes of the societies to the other parts of the world due to the globalization and the presence of expatriates in all countries also increase the number of hobbyists. People from different countries and geographical regions also have started to take up fish keeping as the hobby. Sometimes, the fish keeping is recommended by the psychiatrists as a relief for psychosomatic disorders like depression and high blood pressure.

India has rich and unique biodiversity with a variety of indigenous ornamental fishes. Ornamental fish trade has evolved from the pursuit of a sustainable livelihood alternative, comparable to agriculture or other activities of fisheries in India. The aquaria have entered into houses, schools, tourist places, laboratories, offices, markets, amusement parks, education and also as an advertisement for fresh food fishes and aquatic animals/plants. Marine and freshwater aquaria have got the wide attention of the tourism filed in many cities. There is a rapid growth in the export market and domestic demand.

The world ornamental fish trade is to the tune of US$10 billion in the year 2016 with an average growth of over 10%, while the entire industry including plants, accessories, aquarium, fee, and drugs is estimated to be worth more than the US $ 18-20 billion (Infofish 2016). More than 100 countries are involved in the ornamental fish trade. Asian countries namely Singapore, Thailand, Indonesia, Hongkong, and the Philippines constitute the

significant share among the ornamental fish exporting countries which amounts to 80% of the world export (Cheong, 1996).

The United States of America, European Economic Countries and Japan are the largest markets of tropical fish (Dey, 1996). Eighty percent of the freshwater ornamental fish in the market comes from South East Asia with Singapore and Hong Kong as suppliers. Singapore has its unique record as the center of the ornamental fish culture at the global level as it is the largest producer and exporter(Singh, 2005). Many developing countries have recognized the economic importance of ornamental fisheries for employment generation and livelihoods.

India's contribution is 0.39% of the world exports. According to Marine Product Export Development Authority (MPEDA), as compared to the total marine product export of Rs.30,213 Cr in 2013, the level of ornamental fish export is very low even though it shows a positive growth rate. The increasing tendency is noted from 0.04% in 1991 to 0.15% in 2008 in the share of ornamental fish export. Indian ornamental fish export registered a higher positive compound growth rate of 14.4% of export value. Due to various reasons, the country did not utilize the ornamental fish resource potentially(Sekharan 2006,2008).

The existence of the diverse species of freshwater fishes is a boon to India. The Western Ghats of India is one of the 34 biodiversity hot spot areas of the world. The Western Ghats is having 300 species of freshwater fishes.155 are considered ornamental fishes, of which 117 are endemic to the Western Ghats (Gopalakrishnan and Ponniah, 2000). The fish fauna of the Western Ghats include a large variety of fishes and are quite exotic with their bands, blotches, spots and colorful fins on their body. At present, a small fraction of the endemic fish diversity is utilized in ornamental fish trade. The presence of large verities of the endemic ornamental freshwater fishes in the Western Ghats demands a collective effort to make these resources sustainable.

Ornamental fish production in India was primarily by the small and medium farms and homesteads (Tomey 1986). Dey (1996) had compiled a study on the Indian, domestic ornamental sector consisting of the freshwater, brackish water and marine fishes in his book titled 'Ornamental Fishes'. In the year 1996, the domestic ornamental fish market of India had two hundred full time and one thousand five hundred part-time ornamental fish

breeders. Day (1996) further elaborated the Indian ornamental ichthyofauna which includes freshwater, brackish water and marine fishes, the mass production of both marine and freshwater fishes, diseases and the opportunities for setting up export-oriented ornamental fish units.

Kerala state situated in the south-east side of India is endowed with abundant resources of fresh water. The state has a total freshwater area of about 332,000 ha consisting of reservoirs, rivers, ponds, tanks, irrigation tanks and paddy fields. The appropriate climate of Kerala for the culture of fish verities provides ample scope for the development of this sector. This sector has vast potential in the generation of employment to the people, especially from the rural sector. Kerala has rich and diverse water bodies and better climatic conditions, making it an ideal place for ornamental fisheries development. Ornamental fisheries have benefited from the several roles and endeavors from the part of the state government during the last decade. The low production cost, higher returns within a short time, growing demand in the domestic and international market are the attraction of this sector (Velayudhan, 2006).

According to the data presented on the website of the Department of Fisheries, Government of Kerala, around 163 ornamental fish trade units are functioning in the state of Kerala (www.fisheries.kerala.gov.in). To gain a distinct market demand for the aquarium business service, the existing marketing strategies adopted by aquarists should be analyzed and revised accordingly. Majority of fish species in Kerala Rivers have ornamental value, and some of them have very high demand in the international market. However, more than 83% of the market demand for ornamental fishes in Kerala has been met from the neighboring states (Anon, 2003). The small-scale depended upon the homestead earthen ponds or cement tanks under diverse ecological conditions production has gained the large proportion of the ornamental fish culture.

Martin Thoene (1999) had presented a collection of Indian fishes covering ten orders, 53 families, 119 genera and 250 species which were considered as suitable for aquarium keeping. The present famous trade of ornamental fish in India is mainly concentrated on the exotic species that are bred in captivity.

Majority of the studies conducted under the ornamental fish sector deal with the biological features. Very few studies have concentrated on the socio-economic aspects of this sector. The ornamental fish sector in Kerala stands scattered due to which every member of the supply chain is facing many difficulties.

1.2 RESEARCH PROBLEM

Ornamental fish trade has evolved from the pursuit of a sustainable livelihood alternative, comparable to agriculture or other activities of fisheries in India. The vast potential of ornamental fish trade as a business in the country is remaining to be exploited even though the demand for the ornamental fish from this region is remarkably good. This sector also has the potential to generate employment in the small-scale sector. Difficulties involved in the production and trade of livestock and the added issues of storage and transportations make the ornamental fish business more complicated. The government agencies supporting the small-scale business and the agriculture development are devising plans to help the production and sales of ornamental fish in the country.

A concentrated effort is not yet undertaken to study the ornamental fish sector as a supply chain having different elements and understand the factors affecting the performance of the supply chain members. This information is required to help improve the supply chain of ornamental fish and also attract more players to this business. The necessary information generated from undertaking such a study will be useful to the policymakers as well.

Many studies have been conducted on the supply chain of ornamental fishes, its performance analysis and risk management. India being one among the top few countries having plenty of ornamental fish reserves (Sekharan 2006, Ramachandran, 2006b), possibly for improving the market of ornamental fish supply chain and expanding this business to more geographical areas, the following areas need to be explored.

1. The ornamental fish trade and its supply chain need to be explored with particular significance in the Indian scenario as India is enriched with the two biodiversity hotspots of the world.

2. The performance of ornamental fish supply chain needs to be measured for ascertaining the strategies for improving the supply chain as a whole.

3. Various risks associated with ornamental fish supply chain are required to be identified.

4. The marketing strategies and promotion activities, among the traders of ornamental fishes, need to be analyzed.

5. The level of adoption of green certification programme adopted for the ornamental fish traders and the sustainability practices in the supply chain need to be studied.

1.3 SCOPE OF THE RESEARCH

The Kerala state has tremendous potential for reaping the benefits in the ornamental fish sector. As explained Kerala occupies one of the leading positions in the aquatic biodiversity and having abundantly rich freshwater resources with 44 rivers, nine freshwater lakes, irrigation tanks, reservoirs, streams and, waterfalls, private and public ponds, quarry ponds and waterlogged paddy fields. Majority of the rivers are originating from the Western Ghats and are well known for their richness of biodiversity, including freshwater fish species.

The research work on the ornamental fish supply chain in the state of Kerala is conducted to ascertain its present status and future possibilities as a business venture. The breeders, wholesalers, retailers, customers, transporters and exporters of the ornamental fish supply chain are the sources of data.

1.4 RESEARCH OBJECTIVE

The performance of ornamental fish supply chain, the risks associated with ornamental fish business, marketing of the ornamental fish and sustainability practices adopted particularly with the ornamental fish supply chain of Kerala, India need to be analyzed to understand the ornamental fish supply chain. Such a study will make it more profitable and attract more people to engage in this business for their livelihood.

Hence this doctoral research is carried out with the following objectives.

- To study the ornamental fish business and its activities in Kerala, India by analyzing its scope, potential and problems.
- To identify suitable performance indicators for measuring the performance of the ornamental fish supply chain by developing a conceptual framework for performance measurement.
- To assess the risks associated with the ornamental fish supply chain, and classify the risks.
- To identify the strategies adopted for the marketing of ornamental fish business and its impact on the revenue of the firms.
- To analyze the various promotional activities among the traders and supply chain members of the ornamental fish industry in Kerala and its influence in their business performance
- To explore the sustainable procedures among ornamental fish traders by analyzing the adoption of the proposed Green Certification Programme by MPEDA.

1.5 STRUCTURE OF THIS THESIS

The research work carried out is presented in the following Nine chapters for improving readability and understanding.

1. The first chapter titled "**Introduction**" outlines the business and current status of the ornamental fish supply chain and the research problem and objectives.
2. The second chapter "**Review of literature**" portrays the literature about various dimensions of supply chain management, ornamental fish supply chain, supply chain performance measurement, supply chain risk assessment and sustainability aspects and the information deducted out of the literature survey.

3. Third chapter “**Research Design and Methodology**” gives the design of the current research, and the framework adopted for measurements. It also describes data collection, sample design, questionnaire design and statistical tools employed for doing the research.

4. Chapter four **“Ornamental fish Trade: Kerala Scenario”** gives the first part of the analysis results. This chapter provides the demographic variables of the supply chain and the grouping according to age, experience and educational qualification of members. Different types of fishes in trade and favorite fishes are also explained.

5. Chapter five **“Performance measurement of the ornamental fish supply chain”** gives the results of data analysis on performance indicators and its interpretations.

6. Chapter six **“Risk assessment of ornamental fish supply chain”** provides the analysis results of risks on various categories and its importance.

7. Chapter seven**“Marketing strategies and green certification”** gives adoption of various marketing strategies and sustainability practices by supply chain members.

8. In chapter eight “**Data analysis on sustainability study**” is carried out. The variables of sustainability on general supply chain management and ornamental fish supply chain are identified and the variables are grouped under the three pillars of sustainability namely environmental, social and economic factors.

9. Chapter Nine “**Results and Conclusions”**summarizes the overall findings of the study and provides suggestions to improve the performance and to tackle the various risks associated with the supply chain. It also gives recommendations for the future research.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

A review of the literature is carried out to understand the previous works in supply chain related areas as a whole and the ornamental fish trade in particular. The information gathered from these extant works of previous researchers helped in gaining knowledge of the ornamental fish business as well as the design and conduct of the research.

2.2 METHODOLOGY OF LITERATURE REVIEW

The research paper databases namely SpringerLink, Emeraldinsight, ScienceDirect, Ebsco, Interscience and related papers available on the internet resources are collected by searching with suitable keywords. This existing literature is reviewed in five broad sections. The focus of the work being Ornamental fish supply chains; literature review in this area is carried out initially. Information gained on Ornamental fish trade and its supply chain especially within Kerala is presented in the first section. The literature on supply chain performance measurements and supply chain risk management are reviewed in the second and third sections. After this, literature related to the management strategies of the ornamental fish trade is also presented in this chapter. The literature on sustainability and sustainable supply chain practices are reviewed in the last section.

2.3 ORNAMENTAL FISH TRADE

The available research work on ornamental fish can be classified into six categories, namely aquarium trade and export, related habitat studies, classification of fishes with ornamental value, studies on the biological features of ornamental fishes, assessment of risks associated with the trade and the general studies on fish business. The major papers and the divisions are explained in Table 2.1.

Table 2.1: Classification of Literature in the ornamental Fish Sector

Sl No	Author	Area of Study	Division
1	Singh and Lakra 2011	Aquarium trade in India, risk, and benefit assessment	Aquarium Trade and export
2	Rajeev Raghavan et al. 2013	Freshwater fishes and aquarium pet markets business	Aquarium Trade and export
3	Dalie Dominic et al. 2013	Port-wise ornamental fish export from India	Aquarium Trade and export
4	Selvarasu and Sankaran 2011	Consumer preference and Marketing strategies for aquarium business	Aquarium Trade and export
5	Herath and Wijewardene 2014	Ornamental fish trade in Sri Lanka	Aquarium Trade and export
6	Sankaran and Selvarasu 2012	Marketing of ornamental fish and aquarium	Aquarium Trade and export
7	Davenport 1996	Current international trade in ornamental fish	Aquarium Trade and export
8	Sekharan and Ramachandran 2010	Bottlenecks in the export of ornamental fish from India	Aquarium Trade and export
9	Sekharan 2010	Air freight facilities from India for ornamental fish exports	Aquarium Trade and export
10	Sekharan 2006	Threats in ornamental fish export from India to Singapore	Aquarium Trade and export
11	RushnaAlam et al. 2016	Ornamental fish business trend in Bangladesh	Aquarium Trade and export
12	Prathvi Rani et al. 2014	Competitiveness and determinants of ornamental fish export	Aquarium Trade and export
13	Jayalal and Ramachandran 2016	Export trend in Indian ornamental fish industry	Aquarium Trade and export
14	Leal et al. 2016	Economic perspective study on marine ornamental fish imports in the European Union	Aquarium Trade and export
15	Casey 2016	Ornamental freshwater fish trade in Malaysia	Aquarium Trade and export
16	Arunachalam et al. 2013	Extension of ornamental fish species PuntiusChalakkidiensis	Biological Features
17	Varkey et al. 2013	Length-weight relationship of Puntiusdenisonii	Biological Features
18	Emmanuel et al. 2013	New records of the endangered Travencoria Elongata	Biological Features
19	Nisha, Ganesh and Geetha 2017	Reasons for ailments in ornamental fishes	Biological Features
20	Sirajudheen and Bijukumar 2013	The diversity of marine ornamental fishes in Neendakara fish harbor	Classification of fish species
21	Sureshkumar et al. 2014	Domestication of selected indigenous ornamental fishes	Classification of fish species
22	Vijayasree and Radhakrishnan 2014	The fish diversity of Kuttanad river	Classification of fish species

Sl No	Author	Area of Study	Division
23	Jayalal and Ramachandran 2012	Freshwater fish species in the export market	Classification of fish species
24	Raghavan et al. 2008	Patterns and distribution of fish fauna in Chalakkudy river	Classification of fish species
25	Behera and Nayak 2013	Distribution of ornamental fishes in Chilika Lagoon	Classification of fish species
26	Abraham, Bijukumar and Kelkar 2011	Freshwater fish fauna of Ashambu hills	Classification of fish species
27	Sekharan and Ramachandran 2006	Market preferred indigenous fishes	Classification of fish species
28	Allen et al. 2016	Information about aquarium trade in Costa Rica	Classification of fish species
29	Turkman and Karadal 2012	Imported freshwater decapod species in Turkeys ornamental fish trade	Classification of fish species
30	Bijukumar 2000	Exotic fishes and freshwater fish diversity	Environmental
31	Dykman 2012	Environmental and economic benefits of eco-certification within the ornamental fish trade	Environmental
32	Ramachandran 2010	Eco-labeling and green certification for effective fisheries management	Environmental
33	Marcus Knight 2010	Invasive ornamental fish: Potential threat to aquatic biodiversity	Environmental
34	Priyankalyer et al. 2016	Green certification of aquarium fishes in India	Environmental
35	Harikumar and Rajendran 2007	Overview of Kerala fisheries- with particular emphasis on aquaculture	Environmental
36	Krishnakumar et al. 2009	Exotic aquarium fishes and biological invasions in Kerala	Environmental
37	Jayakumar 1998	Ornamental fish culture and trade: current status and prospects	Environmental
38	Dhanasiri et al. 2011	Application of nitrifying bacteria in ornamental fish transport units	Environmental
39	Sekharan and Subhra De 2010	Study on ornamental fish breeders in India	Environmental
40	Sekharan et al. 2010	Analysis of the factors that hamper the ornamental fish production	Environmental
41	Jayala, Sruthi 2016	Workspace of women in the small-scale ornamental fish value chain in Kerala	Environmental
42	Germain et al. 2015	Ornamental reef fish fisheries: new indicators of sustainability	Environmental
43	MTTolon 2016	Determination of hobbyist preferences for livebearer ornamental fish attributes by conjoint analysis	Environmental
44	Mendoza, Luna and Aguiera 2015	Risk Assessment of the ornamental fish trade in Mexico	Risk
45	Sing and Lakra 2015	Risk-benefit assessment of alien fish species of the aquaculture and aquarium trade into India	Risk

Sl No	Author	Area of Study	Division
46	Sirajudheen et al. 2014	Problems and prospects of marine ornamental fish trade in Kerala	Risk
47	Stevens et al. 2017	Stress and welfare in ornamental fishes: what can be learned from aquaculture	Risk

2.3.1 Aquarium Business and Export

Published work on ornamental fish trade of various species, trade characteristics, export details and economic perspective of the ornamental fish trade are described in aquarium trade and export category. Fifteen papers reporting research work in extend this category are identified from their literature. Identification of categories in domestic and export market, bottlenecks and threats in export and marine ornamental fish categories are also described in this section.

Raghavan et al. (2013) examined the extent and magnitude of collection and trade of endemic and threatened freshwater fish from India for the pet markets and discussed their conservation implications. They analyzed the nature of the export trade from India describing the specious composition, volume, exit points and importing countries. They have also pointed out that the unmanaged collection of these endemic species could be a much more severe threat to freshwater biodiversity.

Dalie Dominic et al. (2013) analyzed the port wise ornamental fish export from India. Selvarasu and Sankaran (2011) studied the marketing strategies and preference for aquarium business service. They developed a marketing scale to measure consumer preferences in the aquarium hobby. Collin et al. (2012) demonstrated that DNA barcoding provides a highly useful biosecurity tool for rapidly identifying ornamental fishes. Herath and Wijewardene (2014) studied the economic perspective of the ornamental fish trade in Sri Lanka. The annual growth rate of ornamental fish business, compound annual growth rate, relative import advantage and comparative trade advantage were studied, and recommendations for increasing the ornamental fish trade were proposed.

Sekharan and Ramachandran (2010) discussed the bottlenecks in the export of ornamental fish from India. They identified the significant constraints faced by the ornamental fish exporters are high fright charges, lack of international flights to desired

destinations, non-availability of quality breeding, the limited availability of exotic fishes, lack of professional farming in breeding and seed production, lack of training in handling and packing and poor marketing strategies.

Sekharan and Ramachandran (2006) studied the threats in ornamental fish export from India to Singapore. As Singapore is an ornamental fish re-exporting country, they identify the reasons of exports from India to Singapore. The primary reasons are lessor export fare and short duration in export and frequent flights. Alrm et al. (2016) discussed the trend of ornamental fish business in Barisal division of Bangladesh. Rani et al. (2014) studied the ornamental fish export from India, its performance, competitiveness, and determinants. The results suggested that India had made tremendous progress in the export of ornamental fish. They identified the major export destinations and recommended diversification of species cultured, innovative marketing and institutional arrangements for improving the export business.

Ekaratne (2000) presented the status of trades of exported ornamental fish resources and their habitats in Sri Lanka. Oliver (2001, 2003) studied the world trade in various ornamental species and their distribution network which gave a clear data on supply and demand situation. Swain et al. (2003) identified common aquarium fishes and provided the prospects of export-oriented freshwater ornamental fish culture in India.

Lee (2005) observed that the new trends in ornamental fish trade in Singapore with particular reference to quality, environmental certification systems and, transportation of traditional ornamental fish industry moving towards a more sophisticated one. Leong (2006) studied the status of the ornamental fish industry in Malaysia. Tomey (1997) reviewed the trends and prospects of the development of worlds ornamental fish trade. The economics of fish production and marketing in Bihar was analyzed by Singh (2003) and, the problems and prospects of aquarium fish trade in West Bengal were studied by Mukherjee (2000).

Jayalal and Ramachandran (2016) also studied the export trend of Indian ornamental fish industry for the last ten years which shows a declining state, and reflected in the annual and compound annual growth rate. They recommended some of the technologies and change in policies for the sustainable development of this export industry.

Leal et al. (2016) discussed the marine ornamental fish trade, especially by EU countries. They described the diversity and evenness between importing and exporting countries. Casey (2016) studied the collection, breeding, and marketing of freshwater ornamental fish trade in Malaysia.

The primary sources of ornamental fish are Asian countries. The major export destinations are the European Union and the United States. Some authors tried to identify the reasons and strengths of Singapore as the significant ornamental fish exporting country. Authors also tried to identify the bottlenecks for improving the trade, significant verities of fishes with ornamental values in different regions and the statistics on exports.

2.3.2 Biological Features

Some authors study the features of ornamental fish species, its length-weight relationships, similarities with other species, diseases in specific categories and its symptoms and reasons. Four papers related to this are classified under the biological features category.

Sajeevan et al. (2013) presented a study with the objective to estimate the length-weight relationship of a species named Pontius demisonii collected from five geographically separated rivers of the Western Ghats, biodiversity hotspots of India. Emmanuel et al. (2013) studied about the endangered species *TravencoriaElongata* from Kerala, part of Western Ghats, India. Nish et al. (2018) studied the pathological infections in the significant ornamental fish verities with samples collected from 2 districts of Tamilnadu. They collected the diseased fishes for the identification of parasites, bacteria, viral and fungal pathogens and analyzed water quality parameters. Arunachalam (2014) describes the biological features of *PuntiusChalakkudiensis* which resemble the favorite aquarium fish *Puntiusdenisonii*.

2.3.3 Classification of fish species

The studies related to the diversity of ornamental fishes in regions, biological classifications of ornamental fish categories, new varieties of ornamental fish with its classifications by the basis of its biological features are grouped under this category. Ten papers related to the classification of ornamental fishes are identified and summarized in

this section. Papers dealing on the export preferences, and studies on customer preference are also included in this classifications.

Sirajudheen and Bijukumar (2013) had conducted a study on the diversity of marine ornamental fishes associated with Neendakara fishing harbor, Kerala. They identified the presence of 138 species belonging to 14 orders 67 families and 108 genera. They emphasized the need to develop technologies for keeping the highly priced ornamental fishes alive onboard while transportation for meeting the demand for ornamental fish which will also supplement the income of the fisherman.

Sureshkumar et al. (2014) brought out the significance of assessing the suitability's of indigenous fishes for the trade before their clandestine and unsustainable exploitation from biodiversity hotspots of India. The experiments on the domestication of native ornamental fishes were done on 20 species of aquarium relevance and, the results were provided. Most of the fishes selected for the study showed good potential for the domestication with higher survival in aquarium and captive condition.

Vijayasree and Radhakrishnan (2014) studied the fish diversity of Kuttanaduriver, Kerala state. They identified and classified a total of 62 freshwater species from 17 families. They divided the fishes into three groups namely Cultivable fishes, food fishes and ornamental fishes. They identified 28 species out of 62 in the ornamental fish category. Jayala and Ramachandran (2012) identified the indigenous exotic ornamental fish species and ornamental shrimp species being exported from India. 287 indigenous fish specious 92 exotic fish species and 44 ornamental shrimps have been found to be exported from India. Rajeev Raghavan et al. (2007) collected 41 fish species belonging to 27 families and 50 genera from Chalakkudyriver, Kerala. They identified the sites in which maximum diversity and species concerning the location and altitude from the main sea level.

Behra and Nayak (2013) prepared a checklist on the distribution of ornamental fishes in Chilika lagoon, east coast of India. 20 species representing 12 families were identified from four sectors of Chilika lagoon. Abraham et al. (2011) prepared a checklist of 103 species with 25 endemics to the Western Ghats from Agasthyamala hills landscape in the south Western Ghats of Kerala. Sekharan and Ramachandran (2006) studied about the market preferred verities of indigenous ornamental fishes of Kerala. Allen et al. (2017)

evaluated the quality of the taxonomic information given in live fish import permits issued by the Costa Rican Ministry of Environment between 1998 and 2004. They found that regulations for ornamental fish imports in Costa Rica are usually not enforced. The lack of accurate information in the line fish permits does not allow the complete understanding and scope of live animal imports and their potential impacts.

Turkman and Karadal (2012) studied the aquarium and ornamental trade in Turkey during 2011. They studied the detailes of the species traded in the aquarium industry in the Turkey. Different authors conducted studies on classification and identification of species traded and available in the different geographical regions and in most of the countries where ornamental fish habitat exists.

2.3.4 Environmental aspects of ornamental fish

Several researchers have conducted studies on the effect of ornamental fish supply chain on environment and biodiversity. These studies are grouped in the environmental aspects of the ornamental fish category. Studies on the environmental implications of specific species, effects of alien species in the ecosystem and biodiversity, methods to improve the current biodiversity problems and preparation of on guidelines for proper handling and culture of ornamental fishes are analyzed in this category. Green certification programme, eco-certification programmes, its guidelines and, recommendations are also identified.

Atul K Singh (2010) studied the aquaculture trade in India. Along with the trade details he discussed environmental, socio-economic and biodiversity issues related to unauthorized culture and spread of alien species. The primary alien fish verities in Indian ornamental fish market and their origin are identified in this paper. The invasiveness and overall impact of various alien species also discussed. According to the studies, alien species even though possess some attractive characteristics generally reduce the availability of local species consequently adversely affecting fish biodiversity and aquatic ecosystem.

Dykman (2012) focused on examining the benefits that accrue from eco-certification of aquaria fish harvesting and trade practices. The study brought out the potential of

certifications as a primary tool in improving sustainability and consumer awareness within the ornamental fish trade. The need for certifications to overcome the market economics of the trade for influencing consumers to prefer certified organisms was emphasised in the studies.

Ramachandran (2010) had studied the use of eco-labeling and green certification for effective fisheries management. The study revealed severe inadequacies in the ecolabels and cast doubt on their overall contribution to effective fisheries management and sustainability. The paper also discussed the initiative taken in India to develop guidelines for green certification programme of freshwater ornamental fishes.

Bijukumar (2000) reviewed the impact of exotic fishes on aquatic biodiversity in India and measures to check this. Knight (2010) discussed the threat of inadequate means of protecting biodiversity due to invasive ornamental fish. They observed that the invasive alien species of fish that have helped the increase in the aquarium trade are emerging as the most critical threats to fragile aquatic habitats. Priyanka at al. (2016) analyzed the current green certification guidelines and found very few constructive and positive suggestions and recommendations for the industry. The critical observation of the study was the emphasis on developing principles and putting systems in place for presenting more scientific guidelines for green certification programme.

2.3.5 Risk in the ornamental fish supply chain

The studies related to the problems faced in the ornamental fish industries are grouped in the risks in ornamental fish supply chain category. Some authors specifically studied and quantitatively analyzed the risks and problems faced by the hobbyists and the traders. Studies related to the risks associated with the culture and trade of alien species and their impact on the biodiversity and present native species are also included in this category.

Sing and Lakra (2011) collected information of alien species imported intentionally which contained 291 ornamental species, 31 aquaculture species and, two larvicidal fishes. They brought out the widespread occurrence of world's worst invasive species in inland waters which are emerging as a threat to aquatic biodiversity. They analyzed the benefits, threats and, risks to the aquatic biodiversity. The results showed that the presence of alien

species reduce the availability of local species and adversely affect fish biodiversity and aquatic ecosystem. Mendoza, Luna, and Aguilera (2015) identified 30 invasive species from 700 freshwater aquarium fish species in Mexico's vast biological diversity that are subjected to risk using the fish invasive screening test.

Sirajudheen et al. (2014) studied the problems and prospects of marine ornamental fish trade in Kerala. The major issues identified were the difficulties in maintaining an aquarium, unavailability of marine fish, varying interest of hobbyists and difficulties in assessing fish species. They also identified the problems of the traders in the marine ornamental fish trade. Krishnakumar et al. (2009) gave a detailed study of the exotic aquarium fishes and biological invasions in Kerala. They analyzed the significant risk factors associated with the rearing of exotic aquarium fishes in open systems.

Stevens et al. (2017) conducted a study on stress and welfare in ornamental fish trade using the welfare indicator in fishes. Stressors occur in the aquaculture and ornamental fish trade was identified and analyzed to examine whether lessons from the aquaculture can be usefully applied to the ornamental fish industry.

2.3.6 General studies in ornamental fish supply chain

Research works on ornamental fish business which deals with the subject area other than the above specific categories are grouped into the general studies category. It includes the studies on aquaculture and ornamental fish trade, ornamental fish trade of specific areas; gender activity in ornamental fish trade, studies specifically related to the members of ornamental fish supply chains and preferences of hobbyists.

Harikumar and Rajendran (2007) tried to identify the resources of fisheries in Kerala state. Detailed description of the marine aquaculture, shrimp farming, brackish water fish farms, ornamental fisheries and problems in the geographical areas were also presented. Ponniah (2009) summarized the current status of exploitation of wild stock, production through aquaculture and the biological, ecological potentials for ornamental fisheries in India by studying potentials and problems of ornamental fish resources. Dhanasiri et al. (2011) evaluated the function as a biocontrol agent by applying nitrifying bacteria in the ornamental fish transportation system.

Jyothilal (1999) described the present status of fisheries development in Kerala. Nair (1999) suggested increasing the production and the employment opportunities in the field of ornamental fish sector of Kerala with the adoption of technologies. Parameswaran (1999) brought out the prospects and problems of ornamental fish development in Kerala. Gopakumar (2004) explored by on the collection, culture, and conservation of marine ornamentals

Sekaran (2010) analyzed the constraints of the ornamental fish breeding sector and suggested methods to enhance production for exports. Factors that hamper the ornamental fish breeders in the five states of Kerala, have been identified and given recommendations to overcome the threats. Jayalal et al. (2016) attempted to determine the gender activity profile in ornamental fish culture and compare the attitude of women in understanding the activity.

Gernian et al. (2014) conducted a participatory SWOT analysis with women-owned and operated the marine ornamental fish business located along the coast of the Gulf of California. Results indicated the existence of financially and ecologically sustainable fisheries in the aquarium market. Tolon (2017) investigated preferences of ornamental fish hobbyists on attributes of live bearer ornamental fish using adaptive conjoint analysis.

The studies conducted on the ornamental fish were reviewed, and the information gained from the review is presented in the previous sections. Researchers have studied the different aspects of ornamental fish trade and on different biological locations. The various researches in this area itself point out the importance of ornamental fish supply chain as a sustainable and environmentally friendly trade.

2.4 SUPPLY CHAIN MANAGEMENT

Supply chain which also known as value chain is a concept from business management that was promoted and popularized by Michal Porter in his book, Competitive Advantage: Creating and Sustaining Superior Performance (Porter M. E; 1985). Supply Chain Management is the management of a network of interconnected business which can be represented in the ultimate provision of product and service packages required by end customers (Harland, 1996).Mentzer et al. (2001) define supply chain management (SCM)

as the "systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a supply chain, to improve the long-term performance of the individual companies and the supply chain as a whole".

A Supply chain consists of the series of activities and organizations that materials move through on their journey from initial supplier to final customers. So supply chain management is the function, responsible for the transport and storage of materials on their journey from original suppliers, through intermediate operations and on to the final customers. Usually, in supply chain management, the point of origin refers to suppliers or manufacturers (Carter at al., 1995) while the point of consumption refers to customers, consumers or the end users in a supply chain (Min and Mentzer 2000).

The most straightforward view of a supply chain has a single product moving through a series of organizations each of which adds value to the product. Taking the organization's point of view – the focus organization- activities in front of it are called upstream, those after the organization are called downstream activities. Supply chain management often refers to the process-oriented management approach to sourcing, producing, delivering goods and services to end customers (Cigolini et al. 2004). The overall aim of the supply chain management is to manage the flow of materials through the supply chain, helping to achieve high customer satisfaction and using resources efficiently to provide the products at low costs. Moreover, SCM addresses the integration of organizational functions ranging from the ordering and receipt of raw materials through the manufacturing processes to the distribution and delivery of products to customers with a view to enable organizations to achieve higher quality in products and customer service and to lower inventory costs for enhancing competitive advantage (Stevens, 1989 and Ohdar and Ray, 2006).

Even though the supply chain has some general principles and its unique features, it is incredibly complicated because of the involvement of large numbers of players with varying interests or objectives. The supply chain management gives answers to manage logistic assets, organize customer management, integrate sales and operations planning, manufacturing and sourcing decisions, strategic alliance and relationship management.

2.5 ORNAMENTAL FISH SUPPLY CHAIN

The supply chain of the ornamental fish sector has five significant elements namely Breeder or catcher, Wholesaler, Retailer, Exporter, and Customer. The transporters also play a significant role as the transportation of the live fish requires special packaging and transportation facilities.

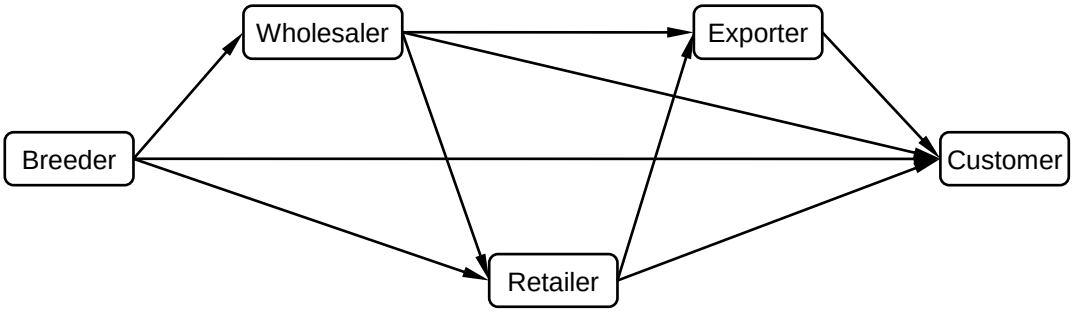


Figure 2.1: ***Ornamental Fish Supply Chain***

2.5.1 Breeders

The first element in the ornamental fish supply chain is the breeders. A person carrying out breeding activity is generally termed as a breeder. However, in this case, any person involved in activities such as breeding, rearing/ growing or combining breeding with marketing activities related to ornamental fish is also described as Breeder.

Unlike Ornamental marine fish, in fresh water 95% of the fish breed in captivity. In the marine sector, the aquatic trade largely depends on the wild harvest. Ornamental fish harvesting is a safe and sustainable source of income for the people living in the areas of habitats. Breeding is often done in the areas far away from wild habitats. The actual structure of the capture varies in different geographical areas. Most of the freshwater fishes and rapidly growing percentage of marine fishes are sourced from breeders.

A survey conducted by Sekharan (2006) identified 1703 breeders in five states of India including Kerala. Of all these breeders 608 were fulltime breeders and 1059 part-time breeders. As per the study, in Kerala, the percentage of breeders is high in the districts Thrissur, Ernakulam, followed by Kottayam and Calicut.

Majority of the ornamental fish breeders have started breeding activity merely out of interest, and they have to be made technically efficient by giving proper training in order to

increase in production. Majority of the breeders in India carries out ornamental fish breeding without any technical training (Sekharan 2010). Cement tanks were the dominant system in the breeding of aquarium fish, followed by ponds, glass tanks, and rings.

Captive breeding has the possibilities of making some variants of known fish species by different breeds. It also provides fish stocks with better-adapted life in an aquarium. Some farms specialize in one species or some related species. Some other farms have a large number of species. Majority of the ornamental fish breeders take it as a part-time job in Kerala. Some breeders are also wholesalers of this sector. In the last ten years, there is an increase in adopting ornamental fish breeding as a profession (Sekharan 2010).

2.5.2 Wholesaler

Wholesalers in the ornamental fish supply chain sector are generally the breeders of some of the species. Even though, they are working as the link between the retailers and breeders. Some of the breeders who carry out the breeding of individual species become wholesaler of that particular ornamental fish species. Another group of wholesalers is breeding some of the verities and also working as a link between the retailer and breeders for other ornamental fish species. A small segment of the wholesaler section in the ornamental fish trade deals with the business of rare and costly species.

2.5.3 Exporters

Exporters are treated as a unique member in this supply chain. The position of India in the export of ornamental fish among the countries involved in the business of ornamental fish export is very low. Singapore, Hong Kong, and Malaysia together imported a significant part of the ornamental fish export from India (Collins et al., 2012). Fish imported from various parts of south and south-east Asia are then repacked and exported to US and EU (Smith et al., 2008).

According to Sane (2005), India has not made her presence felt in the international market for various reasons. As per the study of Sekaran (2010), a cold chain is almost nonexistent in the case of ornamental fish export which leads to many quality issues

especially the high rate of mortality in the ornamental fishes exported. Ornamental fish exporters are very few in Kerala as compared to the wholesalers and retailers.

2.5.4 Transporters

Transporter is an essential link in this supply chain. Without good and reliable international air transport, the development in this sector will show the decreasing tendency. Unforeseen problems will arise while transporting live tropical animals which task requires unique skills and expertise. Collaboration with the transporters is an essential factor for the success of ornamental fish export.

Live animal regulation (LAR) of international air transport association (LAR, IATA 1993) put forward the packing methods of ornamental fishes for export. Packaging is a vital factor in ornamental fish export as it demands the packing of live fish in order to translocate it with less mortality.

2.5.5 Retailers

The nature of Retailers of ornamental fish varies from a simple pet shop with only a few fish tanks containing bestselling fishes to the considerable specialist shops solely constructed to the sale of ornamental aquatics only. Most of the countries have its extreme and medium levels of retailing of ornamental fish.

2.6 PERFORMANCE MEASUREMENTS OF SUPPLY CHAINS

Supply chain management seeks improved performance through the effective use of resources and capabilities via the development of internal and external linkages, thus creating a seamlessly coordinated supply chain (Ketchen and Giunipero, 2004; Ketchen and Hult, 2007). To achieve this objective, it is of the utmost importance to measure the performance of a broad spectrum of tasks which include logistics, inventory management and warehousing, demand forecasting, and supplier and customer relationship management and to manage such performance through a set of practices at the firm and the supply chain levels.

According to critical performance measurement studies, a performance measurement system is a “set of metrics used to quantify the efficiency and effectiveness of actions” (Neely et al., 1995), aimed at supporting the implementation of strategies at various levels (Kaplan & Norton, 1996). A metric is a piece of information within the following three distinctive features:

(1) It is a verifiable performance measure, stated in either quantitative or qualitative terms, that assesses what is happening
(2) It is assessed through a reference or target value
(3) It is associated with the consequences of being on, below or above target (Melnyk et al, 2004, 2014).

Grounding on the necessary performance measurement system definitions and broader scope, supply chain performance measurement systems can be defined as a set of metrics used to quantify the efficiency and effectiveness of supply chain processes and relationships, spanning multiple organizational functions and multiple firms and enabling supply chain orchestration. Challenges exist on identifying appropriate the performance measures for the analysis of the supplychain (Akyuz&Erkan, 2010). Performance measurement helps management as an essential management tool and the path to success to strategically manage and continuously control for achieving the objectives of the supply chains. It also provides necessary information for performance improvement in pursuit of supply chain excellence. An integrated and overall approach needs to be adopted by considering the supply chain as a whole for measuring the supply chain performance (Lambert and Pohlen, 2001; Gunasekaran and Kobu, 2007).

Analyzing the literature on the performance measurement of the supply chains, different types of divisions are possible as per various criteria's. In this study the papers grouped into four categories namely case studies, literature reviews, conceptual papers, and papers reporting surveys. Some of the papers proposed conceptual framework along with a case study. These papers are grouped according to the priority of the subject. The papers related to the supply chain performance along with details and types are given in Table 2.2.

Table 2.2: Papers related the supply chain performance

Sl No	Author	Area of the work/ Purpose	Type of paper
1	Ramanathan et al. (2011)	Proposed a conceptual framework and a standard set of metrics to evaluate the supply chain collaboration	Case Study
2	Saad (2006)	Investigating the variance of supply chain performance concept	Survey
3	SchnitzadPlatts (2004)	Supplier performance measurement framework	Case Study
4	Shaw et al. (2010)	Incorporating environmental measures within a supply chain performance measurement	Conceptual Study
5	Sheperd and Gunter (2006)	Taxonomy of performance measurement and critical evaluation of supply chains.	Literature Review
6	Thakkar, Kanda and Deshmukh (2009)	SCOR process at various levels to report performance measurements for the supply chains in SMEs	Case Study
7	Van Hoek (1998)	Framework for measuring the performance of supply chains	Conceptual Study
8	Chan and Qi (2003b)	Feasibility of performance measurement system in supply chains based on process-based approach	Case Study
9	Olugu; Wong and Shaharoun (2011)	Measures for evaluating performance of the automobile green supply chain	Survey
10	Najmi&Makui (2012)	Conceptual model for performance measurement	Conceptual Study
11	Muralidharan(2002)	Performance measurement model based on the aggregation technique	Conceptual Study
12	Martin & Patterson (2009)	Use of common measurement metrics for measuring the performance of supply chains	Survey
13	Lin & Li (2010)	Performance of an entire supply chain using six sigma matrices	Case Study
14	Li et al. (2009)	Investigatingthe relationship between IT implementation, supply chain integration, and supply chain performance	Conceptual Study
15	Lamber&Pohlan (2001)	Framework focusing on customer relationship and supplier relationship	Conceptual Study
16	Lai et al. (2002)	Supply chain performance constraints in transport logistics	Survey
17	Bigilardi and Botani (2010)	Balanced Score Card model for food supply chains	Conceptual Study
18	Jakhar&Barna (2014)	Comprehensive evaluation tool and decision model to gauge supply chain performance measurement	Case Study
19	Huan et al. (2004)	Analyze strength, weakness of SCOR model and discuss its use in strategic decision making	Conceptual Study
20	Hassini et al. (2012)	Framework for sustainable supply chain management and performance measures	Case Study

Sl No	Author	Area of the work/ Purpose	Type of paper
21	Gunasekharan et al. (2001)	Framework for measuring the strategic, tactical and operational performance in a supply chain	Conceptual study
22	Varma (2008)	Method to evaluate the performance of petroleum industries supply chains	Literature Review
23	Gopal&Thakkar (2012)	Comprehensive review of supply chain performance measurement systems	Literature Review
24	Ganji James Horan, et al. (2015)	Comprehensive model to examine the effect of business analysis on supply chain performance	Survey
25	Elgazzar et al. (2012)	Performance measurement method which links supply chain processes performance to a company's performance strategy	Conceptual Study
26	Lohman et al. (2002)	Empirical findings for the development of performance measurement systems	Case Study
27	Cuthbertson&piotrowicz (2011)	A common framework for empirical analysis	Literature Review
28	Cousins, Lawson & Squire (2008)	Relationship between supplier performance measures	Survey
29	Charan, Shankar &Baisya (2008)	Key supply chain performance measurement system (SCPMS) implementation variables	Conceptual Study
30	BigliardiBotani (2014)	Adoption of performance measurement matrices among manufacturing companies	Case study
31	Amith Kumar &Marwah (2014)	Performance measurement approach in the context of Indian manufacturing organization	Case study
32	Bhattacharya (2014)	Performance measurement framework using intra organizational collaborative decision making	Conceptual study
33	Bhagwat& Sharma (2009)	Classified performance measurement matrices into three levels namelystrategic, tactical and operational	Survey
34	Beamon (1999)	Components of performance measures	Conceptual Study
35	Akyuz&Erkan (2010)	Reviewed the papers on supply chain performance measurement the perspectives of technology, process and people	Literature Review

The papers included in the case study sections contains empirical inquiry that investigates a phenomenon within the real-time context. The significant works tabulated in the case study sections are Ramanathan et al. (2011), SchnitzardPlatts (2004), , Chan and Qi (2003b), Lin and Li (2010),Lamber and Pohlan (2001), Jakhar and Barua (2014), Hassini et al. (2012),Lohman et al. (2002), BigilliardiBotani (2014) and Amith Kumar and Marwah (2014). Jakhar and Barua (2014) proposed a comprehensive evaluation tool and decision

model to gauge supply chain decision model. Thakkar, Kanda and Deshmukh (2009) reported a set of performance indicators for the supply chain process in SME's. This study delivered an integrated performance measurement system for supply chain evaluation in SMEs and outlined the detailed guidelines for implementation. Hassini et al. (2012) provided frameworks for sustainable supply chain management and performance measures and illustrated the experience as a case study in an electric utility company by setting the performance indicators developed. Amith Kumar and Marwah (2014) studied the Indian manufacturing organizations using various parameters in performance measurement approaches. Lin and Li (2010) developed an integrated framework for a supply chain performance measurement system using six sigma matrices and the same is applied to demonstrate the feasibility of the system.

Conceptual development models develop alternative concepts to meet the needs and select a preferred one as the basis of subsequent systems. In supply chain performance measurement and analysis, various models are developed and tested as per the characteristics of the supply chain and members involved in it. Some of the models are mainly developed for specific systems and while others can be used for another and similar type of supply chains with little modifications. Shaw et al. (2010), Van Hoek (1998), Najmi and Makui (2012), Muralidharan (2002), Li et al. (2009), Lamber and Pohlan (2001), Bigilardi and Botani (2010), Huan et al. (2004), Charan, Shankar and Baisya (2008) reported conceptual development studies in the field of supply chain performance measurement. Battacharya (2004) proposed a framework for the performance measurement of the supply chain using intra organizational collaborative decision making. Cuthbertson and Piotrowics (2011) proposed a common framework for the empirical analysis of the supply chain performance measurement systems used in different supply chain contexts.

The number of review papers is very less as compared to the conceptual and case study. The major literature review in the area of supply chain performance measurement is Sheperd and Gunter (2006), Varma (2008), Gopal and Thakkar (2012), Cuthbertson and Piotrowics (2011) and Akyuz and Erkan (2010). In this studies, the review of papers is carried out in various perspectives. Akyuz and Rekan (2010) reviewed the papers on the perspectives on technology, process, and people. Gopal and Thakkar (2012) reviewed the

supply chain performance measurement matrices of the papers from 200 to 2011. After the vigorous selection process by measures and matrices, they segregated the papers based upon title, author, approach and focus.

Survey-based studies in the field of supply chain performance varied as per the type of the study and its objective. Majority of the studies were carried out to find the overall supply chain performance of an organization or industry (Saad 2006, Olugu, Wong, and Shaharoun 2011, Martin Patterson 2009, Li et al. 2002). However, in some cases, surveys were conducted for assessing the performance of the components of the supply chain like supplier performance (Cousins, Lawson & Squire, 2008).

2.6.1 Indicators on Performance Measurement

Several research works were conducted on developing the indicators that can be used for supply chain performance measurement. Different authors from different disciplines have their views about supply chain performance measurements. For useful performance measurement and improvement, there should be a balance between financial and nonfinancial measures that can be related to strategic, tactical and operational levels of decision making. Measurement goals must represent organizational goals and metrics selected should reflect complete supply chain behavior (Gunasekaran et al. 2004).

Various dimensions have been considered by researchers for the measurement of performance of supply chains. In earlier years cost was considered as the essential factor to measure supply chain performance (Cohen and Lee 1998). Customer responsiveness has also been recognized as an essential dimension of supply chain management performance (Christy & Grout, 1994). Lee and Bullington (1993) identify supply chain flexibility as an important measure of supply chain management performance.

It was recognized that supply chain performance should be evaluated from the tactical, strategic and operational levels as well as from the commercial and non-commercial perspective (Gunasekaran, Patel and Tirtilogru 2001). According to Maskell (1991) in the case of strategic decisions, financial performance measurements are important even though day to day controls of operations are always handled well with nonfinancial measures.

Several indicators have been proposed by researchers to develop the performance measurement system for different types of supply chains. These indicators and their area of usage are summarized in Table 2.3.

Table 2.3: **Performance indicators used in various supply chains**

Sl No	Author	Performance Indicators	Application/Area
1.	Beamon and Balcik 2008	Resources, Output, Flexibility	Humanitarian Relief Chain
2.	Bigliardi and Botani 2010	Cost, Customer, Internal Process, Innovativeness	Food Supply Chain
3.	Srivastava 2013	Purchasing, Manufacturing, Logistics, Customer service	Information technology Enabled Industry
4.	Aramyan et al. 2007	Efficiency, flexibility, responsiveness, food quality	Agri-food supply chain
5.	Bhagwath and Sharma 2009	Cost, customer, internal process, Learning and development/innovativeness	Model to all supply chains
6.	Chan and Qi 2003b	Efficiency, utilization, productivity, time, responsiveness, reliability, flexibility, cost	General model
7.	Charan 2012	Quality, cost, delivery, new product development	Indian Automobile sector
8.	Gunasekaran et al. 2004	Plan, source, make/assemble, delivery/customer	Selected British companies
9.	Cox,Jie and Parton 2012	Lead time, cost, capacity, quality, delivery, flexibility	Agri-food Supply chain
10.	Lohman, Fortuin and Wouters 2004	Resources, output, flexibility	European operation department of Nike
11.	Gunasekaran et al. 2001	Planning and product design, supplier, production, delivery, customer	Strategic, tactical and operational level measurement
12.	Cumbo, Kline and Bumgardner 2006	Order till the delivery lead time, change over or set up times, skill, timely shipment, reduction in inventory	Performance measurement of the rough mill
13.	Zhu et al. 2005	Quality of product, solid waste, utilization of capacity, consumption of unsafe and toxic supplies, air emissions, cost of training, cost of operation, levels of inventory	Chinese Manufacturing organizations.
14.	Varma et al. 2008	Cost, customer, internal process, innovativeness	Petroleum industry supply chain
15.	Bigliardi and Botani 2014	Finance and marketing, Customer service, innovation and learning, transport and logistics, internal business, supplier performance.	Italian Manufacturing Companies.
16.	Amith Kumar Marwah et al. 2014	Supplier-buyer relations, external supply chain, environmental factors, human metrics, information sharing	Indian Manufacturing organizations.

In the recent studies new sets of performance indicators are added by the researchers in order to measure the performance of the supply chain. Bigliardi and Botani

(2014) used finance and marketing, customer service, innovation and learning, transport and logistics, internal business, supplier performance as the performance indicators for measuring the performance of the Italian manufacturing companies. Amith Kumar and Sharma (2014) used Supplier-buyer relations, external supply chain, environmental factors, human metrics, and information sharing for measuring Indian manufacturing company's performance measurement.

Similarities can be observed in the indicators used for the performance measurement of the supply chains with an entirely different organizational structure. Charan (2012) used quality, cost, delivery, and new product development as indicators for the performance measurement of the Indian automobile sector while Jie, Patron and Cox (2012) taken lead time, cost, capacity, quality, delivery, and flexibility are the indicators for measuring agri-food supply chain. Quality, flexibility and cost were the common indicators even though the two supply chains were entirely different. In all the recent studies, it is evident that the importance was given to the customer service or customer related activities apart from the cost of the product (Bigliardi and Botani 2014, Bhagwath and Sharma 2009, Srivastava 2013, Amith Kumar Marwah et al. 2014).

2.7 SUPPLY CHAIN RISK ASSESSMENT

The risk is the chance of danger, damage, loss, injury or any undesired consequences. Royal Society (1992) defined risk as "The probability that a particular adverse event occurs during a stated period, or results from a particular challenge. As a probability in the sense of statistical theory, risk obeys all the formal laws of combining probabilities". The consequences of risks are not easy to manage. Critical incidents may influence another member of the supply chain in a hostile manner and distort their perception of the company or the brand.

There are numerous interpretations of risks in the academic sphere. The widely deliberated variance based definition is drawn from classical decision theory, where risk is the variation in the distribution of possible outcomes, their likelihoods, and their subjective values. In this hazard focused risk measurement, the numeral value of risk can be measured in terms of the probability of the given event multiplied by the negative business

impact. March and Shapira (1987) consider risk as the variation in the distribution of possible outcomes, their likelihoods, and their subjective values. Zsidisin et al. (2003) defined risk as a detrimental event with relatively high likelihood, and that event has a significance associated with impact or cost. Peck (2006) proposes risk as a "measure of the possible upside and downside of a single rational and quantifiable decision". Stemmler (2006) describes that "risk denotes the chance of danger, loss or injury". Supply chain risk management has to deal with all aspects of risk to the supply chain.

Supply chain risk management is the "management of supply chain risks through coordination or collaboration among the supply chain partners to ensure profitability and continuity" (C.S Tang 2006). Norrman and Lindroth (2002) defined supply chain risk management as collaborating with parties to deal with risks and uncertainties caused by or impacting on logistics related activities or resources. The aim of supply chain risk management is the identification and management of risks for the supply chain, through a coordinated approach among supply chain members to reduce supply chain vulnerability as a whole (Juttner et al. 2003). Generally, Supply chain vulnerability is defined as an exposure of the supply chain to severe disturbances, arising from risks within the supply chain as well as risk external to the supply chain. There is no clear consensus on the definition of supply chain risk management (M.S.Sodhi, C.S.Tang 2012).

The literature on the supply chain risk can be classified into three broad categories according to the subject area of the paper. The categories are the papers dealing with conceptual studies, empirical studies, and analytical studies. Table 2.4 describes the categories of the study in the field of supply chain risk management and industry which the study is performed.

2.7.1 Conceptual Study

The number of research works dealing with the conceptual research is the largest, as compared to the other papers in the field of supply chain risk management. In conceptual development papers, the researchers discussed the fundamental risk issues, propose theoretical models and frameworks to manage risk issues and attempted to classify the risks, uncertainties and associated issues. In conceptual studies, most of the papers

focused on theoretical aspects related to the risk issues, usually inspired by financial risk theories. The humanmade incidents and natural catastrophes happened in the recent years, their effect and losses on the supply chain also have motivated researches to redefine risk issues for business continuity and develop solutions for the speedy recovery of the supply chains after disruptions.

2.7.2 Empirical Study

The studies which used an empirical approach with the conduct of surveys followed by statistical design and structured case studies are included in this category. The empirical study and approaches have been used to establish relationships amongst latest supply chain issues. Majority of the works carried out under the empirical study category are the survey based statistical designs to develop relationship models. Case studies on supply chain risk management in different industries were also carried out as shown in Table 2.4. Case studies in agriculture, agro-business, automobile manufacturing, aircraft manufacturing, small-scale industries and electronic industry are carried out by various researchers. The major areas of the research were value and risk assessment, investigation on outsourcing decisions, investigation on the supply risks, issues related to practitioners point of view, flexibility in supply chains, disruptions in supply chains and risk and information sharing issues. The primary areas of the research are categorized in Table 2.4.

Table 2.4: Literature classification in supply chain risk assessment

SL No	Author	Paper Description	Category	Industry
1	Ritchie and Brindley 2007	Supply Chain Risk Management and performance	Conceptual Study	Miscellaneous
2	Kim and Park 2008	Integrated model in Supply Chain using Genetic Algorithm	Analytical Study	Miscellaneous
3	Manuj and Mentzer 2008	Global Supply Chain Risk Management Strategies	Conceptual Study	International business
4	Hung and Sungmin 2008	Changing risk preferences in the supply chain	Empirical Study	Agriculture Sector
5	Tang and Musa 2010	Identification of risk issues	Conceptual Study	Review Paper
6	Khan and Greaves 2008	Mitigating supply chain risk through improved agility	Empirical Study	UK retailer industry
7	Zsidisin et al. 2008	Cultural differences in Supply chain risk perception practices	Empirical Study	US and UK Managers

SL No	Author	Paper Description	Category	Industry
8	Oke and Gopalakrishnan 2009	Managing Disruptions	Empirical Study	Retail Supply Chain
9	Braun Scheidel and Suresh 2008	Supply chain agility for risk mitigation	Empirical Study	Miscellaneous
10	Liston et al. 2007	Contract costing in outsourcing	Analytical Study	Electronics Industry
11	Mele et al. 2007	Agent-based approach for supply chain retrofitting	Analytical study	Miscellaneous
12	Lee 2008	Drivers for the participation of SMEs	Analytical study	SMEs
13	Sohn and Lim 2008	Effect of forecasting in SCM	Analytical study	Electronics Industry
14	Kleindorfer and Saad 2005	Managing disruption risks in the supply chain	Analytical study	Chemical Industry
15	Thun and Hoenig 2011	Empirical analysis of supply chain risk	Empirical Study	Automotive Industry
16	Tang and Musa 2010	Identification of risk issues	Conceptual study	Review paper
17	Thun, Druke and Hoenig 2011	Managing uncertainty	Empirical Study	Small and medium-sized industries
18	Wagner and Bode 2007	Investigation into supply chain vulnerabilities	Empirical Study	Miscellaneous
19	Basselt and Gardner 2010	Design optimization of global supply chain	Analytical study	Agro Science
20	Diabat, Govindan and Panicker 2012	Supply chain risk mitigation	Empirical study	Food industries
21	Chaudhuri, Mohanty and Singh 2012	Risk assessment during new product development	Analytical study	Aircraft manufacturing
22	Diehl and Spinler 2013	Defining common ground for supply chain risk management	Conceptual study	Consumer goods
23	Chappell and Peck	Role for six sigma in risk management	Conceptual study	Military supply chain
24	Mena, Khan Yurt 2011	Managing global sourcing risk	Conceptual study	
25	Lavastre, Gunasekaran and Spalanzani 2012	Risk Management	Empirical study	French Companies
26	Walls et al. 2015	Network model with epistemic uncertainty	Analytical study	Medicine supply chain
37	Heckman, Comes and Nickel 2015	A critical review of supply chain risk	Conceptual study	Miscellaneous
28	Keilhacker and Minner 2017	Risk management for critical commodities 2017	Analytical study	Miscellaneous
29	Peng, Peng and Chen 2014	Post Seismic supply chain risk management	Conceptual study	Miscellaneous

SL No	Author	Paper Description	Category	Industry
30	Qazi, Qigley and Dickson 2015	Literature review to capture interdependencies between risks	Conceptual study	Miscellaneous
31	Lavastre, Gunasekaran and Spalanzan 2014	Effect of firm characteristics and supplier relationships	Empirical study	French companies
32	Zepeda, Nyaga and Young 2016	Risk management and hospitality inventory	Empirical study	Miscellaneous
33	Behzadi et al. 2018	Quantitative decision models	Conceptual study	Agri- business
34	Boyson 2014	Cyber supply chain risk management	Empirical study	Miscellaneous
35	Aqlan and Lam 2015	Fuzzy based integrated framework for supply chain risk assessment	Conceptual study	Server manufacturing
36	Ponis and Ntalla 2016	Supply chain risk management and framework	Conceptual study	Miscellaneous
37	Mostataepipour et al. 2017	Fuzzy rank function model	Analytical study	Miscellaneous
38	Wang, Foerstl and Zinnermann 2016	Cross-functional and multi tier perspective	Empirical study	Automobile industry
39	Septiani 2016	Mapping for Agri-food supply chain risk management	Conceptual study	Agri-food
40	Ghamari and Irohara 2017	Comprehensive review	Conceptual study	Miscellaneous
41	Rajesh and Ravi 2015	Supply chain risk mitigation	Analytical study	Electronics
42	Baske, Land and Seuring 2014	Sustainable supply chain practices	Conceptual study	Food industry
43	Nadarajan and Balakrishnan 2016	Internal Process risk management	Conceptual study	Electronic
44	Araunjo et al	Supply chain risk management	Empirical study	Automotive
45	Sharma and Bhat	Supply chain risk management dimensions	Empirical study	Automobile industry

2.7.3 Analytical Study

The research works grouped under this category are those studies conducted to quantify the risks. Different researchers employed mathematical modeling, simulation modeling or agent-based methods in modeling. The tools used were also different. Some of the tools used are linear programming models, integer programming models, dynamic and

stochastic models. The details of the papers carrying under this category are also tabulated in Table 2.4.

Analytical approach adopted by most of the researchers was to rank the risks by using any of the methods. By ranking the risks, it is possible to find out the major risks, its probability and effects in the supply chain. By considering the nature of the risk, the stochastic models are more accepted in supply chains to model risk issues (Beamon, 1998). Each variable is associated with some uncertainty or the probability of occurrence. In the studies, the uncertainties are modeled with three approaches. In fundamental problems with simple variables, some standard probability distributions with continuous probability distributions are assigned. If it is not possible, discrete finite scenarios are established. In the third case fuzzy approaches are used, where decision parameters are considered as fuzzy numbers. The unrealistic assumptions and complexities limit the utility of mathematical modeling.

As an alternative approach, simulation methods are used to analyze the supply chains by constructing an artificial environment within which the dynamic behavior of the risk can be assessed. Simulation can be done with various parameters like seasonality, level of information sharing, and service level. However, limitations are also associated with simulation models, as it runs only with previously defined conditions. Majority of studies carried out under this category are on evaluating the risk ranks, quantification of risks using mean-variance analysis, uncertainty quantification, planning under uncertainties, structuring of the network under uncertainty and collaboration under uncertainties.

2.8 Risk Categories in Literature

The supply chain risk management is classified into two dimensions namely operational risks and disruption risks(Tang 2006). Operational risks include uncertainties such as uncertain customer demand, uncertain supply, and uncertain cost. Disruption risks include risks caused by natural or humanmade disasters such as earthquakes, floods, hurricanes, terrorist attacks or economic crisis such as currency devaluation or strikes. Tang (2006) has surveyed the research works on risks and classified the risk management research works according to four basic approaches namely supply, demand, product, and

information management. Significant categories of risks and areas where the categorizations are carried out in the recent researches are tabulated in Table 2.5.

Supply chain risks are also categorized into supply, operations, demand risks and other risks which include security and current risks (Manuj and Mentzer 2008a). Manuj and Mentzer (2008b) created an integrated framework for global supply chain management with five-step approach namely risk identification, risk assessment and evaluation, selection of appropriate risk management, implementation of appropriate risk management strategies and mitigation of supply chain risks. They categorized the risks as supply, operational, demand, security, macro, policy, competitive, and resource risks. With the levels of uncertainty on demand and supply, they differentiate four types of supply chains and assign seven risk management strategies as avoidance, postponement, speculation, hedging, control, transferring/sharing risk and security to these supply chains. Wagner and Bode (2008) divided sources of supply chain risk into five categories namely demand side, supply side, infrastructure, catastrophic and bureaucratic, also examined the influence of supply chain risks on the performance of the supply chain.

According to Water (2011), the risks are categorized into internal risks, risks outside of the company or organization within the supply chain and risks outside of the supply chain that affect the focal company. Internal risks arise from the operations of the company. Within an organization, it can be due to the operations (include risks by accidents, reliability of equipment, human errors, loss or information technology) or it may arise directly from the manager's decisions (choice of batch size). The risk from suppliers and customers include in the second category and risk of accidents, extreme weather, legislation and natural disaster. are coming under the third category.

Merna and Smith (2009) gave a broad classification of risks in supply chains in 22 titles namely strategic, natural, political, economic, physical, delivery, supply, market, transport, product, operations, financial, information, organization, management, planning, human, tactical, criminal, safety, environment, and local permits. Kleindorfer and Saad(2005) investigated a data set of accidents in the US chemical industry and categorized supply chain risks as process, control, demand, supply and environmental risks and also developed a conceptual framework for managing risks of supply chain disruptions.

Table 2.5: Major risk categories in recent literature

Sl No	Author	Risk Categories	Application
1	Wagner and Bode (2008a)	Demand-side risk, Supply risk, regulatory, legal and bureaucratic risk, Infrastructure and catastrophic risk	To examine the link between supply chain risk sources and supply chain performance
2	Chopra and Sodhi (2004)	Disruptions, delays, systems, forecast, intellectual property, procurement, inventory, capacity	Industries and companies
3	Christopher and Peck (2004)	Demand, Supply, Environmental, process, control	Industries risk measurement
4	Hallikas et al. (2004)	Insignificant, minor, severe or catastrophic	Risk measurement in partnership
5	Kleindorfer and Saad (2005)	Operational contingencies, natural hazards, earthquakes, hurricanes, terrorism, political instability	Disruption risk management
6	Harland Christine et al. (2003)	Financial, performance, physical, social, psychological and time	Risks in supply networks
7	A Diabat et al. (2011)	Macro-level risk, demand management risk, supply management risks, product/service management risk, information management risk	Risk management in food supply chain
8	Manuj and Mentzer (2008)	Supply risks, operational risks, demand risks, security risks, macro risks, policy risks, competitive risks, resource risk	Framework for global supply chain management
9	Faisal, Bannet, and Shanker(2007)	Physical, informational, relational and financial risks	Model of supply chain susceptibility using SCOR model
10	Tang and Tomlin (2007)	Supply risks, process risks, demand risk, political/social risks, intellectual property risk, and behavioral risk.	Flexibility strategy for mitigating supply chain risk.

Zsidisin (2003) presented supply risk assessment techniques and supply risk management by considering design, quality, cost, availability, manufacturing, suppliers, legal and environmental, health and safety issues and categorized nineteen risk factors into five families. Based on the case studies conducted he has recommended that the organizations may assess supply risks with techniques focusing on addressing supplier quality issues. Organizations can improve supplier process through proper communication, conducting process maturity path analysis and developing and certifying suppliers. The organizations can reduce the likelihood of supply disruptions by creating business interruption plans, developing demand forecasts and modeling supply processes.

Martin Christopher et al. (2011) have classified risks into a fourfold category, namely supply risk, process and control risks, environmental and sustainability risks and demand risks. Chidambaram (2003) identified the steps involved in handling risks as risk classification, risk identification, risk calculation, and implementation/ validation. Diabat et al. (2012) proposed a model which analyzes the various risks involved in food supply chain by clustering all the types of risks into five categories namely macro-level risks, demand management risks, supply management risks, product/ service management risks and information management risks.

The mode of identification and classification of supply chain risk by an organization is a difficult question posed, as it may depend on different factors that include the characteristic of supply chain and the nature of the products. There is no standard approach for classifying or assessing supply chain risks (M. S. Sodhi and C.S Tang 2012).

Risk identification is a complicated process. It is by no means an exact science. There are tremendous numbers of possible risks related to the supply chains with its characteristics, so many of them are unidentifiable, that we cannot recognize and appear out of the blue. Identifying supply chain risks is challenging because a risk incident can have different impacts on different entities in the supply chain. The supply chain risk management aims to ensure that supply chains continue to work as planned, with smooth and uninterrupted flows of materials from initial suppliers to final customers.

2.9 MARKETING STRATEGIES AND SCHEMES

The business environment is becoming very competitive in nowadays. To compete, the sellers need to organize a good strategy. The concept of marketing holds the key to achieving organizational goals by determining the needs and wants of the market and delivering desired satisfaction more effectively and efficiently than competitors. Chanston (1984) states that the widely accepted image of marketing is that, it is merely responsible for promoting the product in order to increase sales. American marketing association defines marketing as the process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchanges that satisfy individual and organizational objectives (Bennet,1988).

Chanston (1984) stressed the need to identify the current product by analyzing the needs of the customers in the market sector in which company operates, in order to satisfy the customer needs by offering the current attributes of the product. The company begins to use the variable price, promotion, and distribution to generate the required level of sales only at this point in the marketing process.

Formulation and adaptation of a growth strategy are significant for any business in order to serve and develop ahead in the market, getting bigger and increasing annual sales over time. Competitors may destroy the business if the organizations do not have a competitive advantage that can attract the customer's attention. A business will fail if it cannot compete with its competitors. Chabowski, Mena & Gonzalez-Padron (2011) supported that marketing plays an essential role in driving the firm's performance.

Promotions is a way, where the sellers communicate with their customers, and it is also a way to attract the customers. Pauline and Philippe (2012) presented a view that sales promotion can improve customer efficiency during the purchase by reducing search costs. Sales promotion techniques are instruments that seek to increase sales of products and brands usually in a short time (Wierenga&Soethoudt, 2010) because, they work for creating consumer behavior approach in the consumer's mind and thus benefit to their business (Yususf, 2010).

In the purchase intention of the people, it is believed that sales promotion has a positive influence. According to the studies of Capbell and Diamond (1990) and D,Astous and Landreville (2003), sales promotion are distributed into two groups namely price or monitory promotion (ie, discounts, coupons, rebates) and non-monetary promotions not geared to price (free samples, distribution of promotional prices, gifts, contests and loyalty programmes.

Television, radio, magazines, and newspapers conquered the advertising globe all over the 20th century; however internet has continued to attain status between advertisers since its fast growth in the 1990's. According to Vandic et al. (2013), the most effective marketing approach is one that uses social media and traditional marketing in series. Social media marketing has a beneficial effect on the attainment of business goals, and this is a method that takes a small amount of capital to attain the excellent result.

According to Frost (2011), online advertising is useful in business. Stelzner (2011) claimed that the effect of online advertising on business is commonly persistent. Now the trend towards increased online advertising makes the family more susceptive to marketing. Lindstadt and Budzinski (2012) stated that many firms had extended their marketing expenses to online advertising. However, by the study conducted by Sissors and Baron (2010) online advertising can be useful for high-cost products such as automobiles and electronic systems. Advertising on social networks is moderately inexpensive compared to other traditional media (Babu et al. 2010). They also stated that people are spending huge time online especially on social networking websites.

Advertising has always influenced human culture and dealings. Advertisements can be applied through any media; printed electronic or web (Clow 2007). Web and digital media have more opportunities to grow and fetch more visitors than traditional ones (Millor, 2012). In the 20th century television, radio, magazines, and newspapers conquered the advertising realm, however post 90s; the internet started to occupy the space gradually. Later, after the development of social media, researchers found that the practical way of advertising is the usage of social media and traditional marketing (Vandic, Nibbering, and Frasincar, 2013).

2.10 SUSTAINABLE PRACTICES IN SUPPLY CHAINS

In the current literature, the term ‘sustainable' is prevalent. Generally, it means and discusses the business responsibility concerning customer satisfaction along with respect towards nature, and it’s safety. The current ecological challenges demand the managers, formulate strategies that control pollution and preserve natural resources. The growth of industries with green tag indicates the favorable attention of the customers and the marketers. There is some evidence that various types of companies switch to adopt green philosophers such as traditional manufacturers which have become more profitable after the turn of the transform to green manufacturing system (Tylor, Chuangs& Yang, 2013). The hotel and tourism industries also involved in changing their businesses towards green hotel and ecotourism (Graci and Dodds, 2008; Punitha and Mohammed Rasdi, 2013; Chan, 2013).

The size of the green market is increasing and is getting bigger in the future. The number of consumers who are willing to purchase the environmentally friendly products is growing significantly, and the concept of buying green products become popular now (Dangeloco and Pujari, 2010). It is also found that people in India have a high concern for the greener environment (Saxena and Khandelwal, 2010).

Chamorrow and Banegil (2006) stated that the objective of the green marketing is to decrease the impact on the natural environment. This concept will play a vital role in the process of planning and implementation of products or services, price, place, and promotion. Moured and Ahmed (2012) pointed out that the goal for green marketing is to create profit and maintain the social responsibility. Sarkar (2012) also agreed that green marketing encompasses a broad range of activities including product modification changes to the production process, processing changing, remodeling, and styling as well as modifying advertising.

Sustainability is defined as “using resources to meet the needs of the present without compromising the ability of future generations to meet their own needs” (Daly and Cobb1994). Since supply chain considers the product from initial processing of raw materials to the delivery of the customer, a focus on the supply chain is a step towards the broader adoption and development of sustainability. European Union has a highly influential proponent of sustainability. There are sufficient activity and ongoing growth in the area of sustainability.

The World Commission for Environment and Development (1987) defined sustainable development as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Business enterprises are under intense pressure to measure their impacts on the environment and to engage in 3 BL reporting to account for the energy and their resources they use and the resulting footprint they leave behind (Corbett and Kleindorfer 2001a). Community pressure and the threat of liability can drive companies to improve their environmental performance (Snir 2001). Sometimes companies themselves lobby for regulations if they have developed an environmentally friendly technology and believe that regulations requiring their technology would give them a competitive advantage.

Elkington (1997) is credited with popularizing the three dimensions, which he called the "Tripple Bottom line" principle, also known as three pillars, profit, planet, and people. The companies issue periodic TBL reports to their stakeholders as a sign of their sustainability practices. In the literature of business disciplines such as management and operations, the term sustainability which increasingly refers to an integration of social, environmental and economic responsibilities has begun to appear.

Triple bottom line concept developed by Elikington (1998, 2004) simultaneously considers and balances economic, environmental and social goals. Some of the definitions from sustainability literature also include risk management (Shrivatsava, 1995a) transparency (Holliday et al. 2002, Friedman 2005) strategy and culture (Sayiz and Weber 2006).

Interaction with economic consideration with social and environmental issues, such as noise pollution and carbon dioxide emission has been considered by Quack and de Koster (2007) in their work on exploring retailors sensitivity to sustainability policies. Analyzing the past 20 years, there has been growing pressure on business to pay more attention to the environment and resource consequences of the products and services they offer and the process they deploy.

Hassini et al. (2012) defined sustainable supply chain management as the management of supply chain operations, resources information, and fund in order to maximize the supply chain profitability while at the same time minimizing the environmental impacts and maximizing the social wellbeing. Carter (2008) defined sustainable supply chain management as "the strategic transparent integration and achievement of an organizations social, environmental, and economic goals. The system coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains".

`Manufactures are now moderating the practice, developing designs that avoid environmentally hazardous components that have high reuse value. (Krikke, Bloemhot-Ruwaard and Van Wassenhove 2003). It was found that in a vast majority of organizations, the incorporation of sustainability issues is a new area of activity and many have yet to begin managing them in their supply chain.

Social issues are perceived by many to be less tangible, challenging to measure and there for more difficult to address (Young 2001). Therefore very few organizations have clear lines of responsibility and clear objectives and targets for dealing with social and ethical issues even if they have signed up to social and ethical codes of conduct.

Social wellbeing is used to define how the supply chain treats its employees, customers and the community at large. Focus on sustainable practices in the small and medium enterprises (SME's), are supported by some of the studies and literature (Tomomi 2010, Moore and Manring 2009, Lee and Klassen 2008 and Lee 2008). The significant challenges the SME's face about the adoption of sustainable practices in the supply chain is the significant upfront cost of greening.

Supply chain professionals are in an outstanding position to impact sustainability practices by activities such as fuel efficient transportation, improving working conditions of warehouses, reducing packaging and requiring suppliers to undertake environmental and social programmes. Sarkis et al. (2011) have given an extensive review of the green supply chain management process and expect that the domain of sustainability should be considered in strategy development at the same level as traditional factors like cost efficiency and quality.

Due to socio-economic and livelihood benefits, the ornamental fish industry is viewed as positively while due to overharvesting, habitat destruction and alien species invasion it is also negatively influenced (Watson and Morean 2006). Certification schemes are being proposed to counter the issues arising from unsustainable fishing practices (Jacquet and Pauly 2007). There are mixed responses on whether certification is required or not (Tlusty, Dowd and Von Halle 2006). Outlines for Green Certification of ornamental fishes in India (Silas et al., 2011) is developed by Marine Product Export Development Authority of India (MPEDA) under the ministry of commerce and industry, Government of India. The Green Certificate will give an assurance that the fish has been caught/produced/reared in a manner which ensures the social and environmental sustainability and certifies its supreme quality regards to health and biosecurity issues.

Green certification programme is the first of its kind in the ornamental fish sector (Jayalal and Ramachandran 2012), which helps to maintain the environmental and socio-

economic sustainability. The approach stresses on reducing the dependence on wild stocks and ensuring that the fish collection is managed according to the principles of ecosystem management (Silas et al. 2011). Green certification can take on strategy for improved marketing in addition to ensuring sustainable harvest. Priyanga et al. (2016) listed the gaps in information in the green certification programme, which is developed to ensure the sustainable harvest of the freshwater fishes to ensure the sustainability practices. Even though green certification programme has only a peripheral aim to ensure the sustainability, it is highly essential to check the awareness of green certification programme and its procedure within the members of the ornamental fish traders.

The principal works in the field of sustainable supply chain literature are classified into the fields of automobile, agriculture & food, electrical and electronics supply chains, manufacturing sector. The classification with details and perspective of the study are discussed in Table 2.6. The sustainable studies in the literature are divided into five major categories namely studies on the automobile, agriculture and food, electrical and electronics, manufacturing, and general literature study.

Table 2.6: Studies related to sustainability with factors and area of study

Sl No	Author	Paper description	Factors Used	The perspective of the study	Area of the study
1	Luthra, D Garg and Haleem (2015)	Success factors in the green supply chain of Indian automobile industry	Internal management, customer management, regulations, supplier management, social and competitiveness	Economic, social, operational and environmental	Automobile industry
2	M. Giannakis and T. Papadopoulos	Supply chain sustainability: A risk management approach	Factors in environmental, social and economic sustainability	Environmental, social and economic perspective	Textile manufacturing
3	Jorg H. Grimm, Jeorg S. Hotsteller, Joseph Sarkis (2014)	Success factors in the sustainable food industry	Identified 14 critical success factors	Environmental, Social and Economic perspective	Food industry
4	Cambero, Sowlati (2014)	Assessment and optimization of forest biomass	Factors in environmental, social and economic perspective	Economic, social and environmental perspective	Agriculture

Sl No	Author	Paper description	Factors Used	The perspective of the study	Area of the study
5	Yongjan Li et al. (2014)	Governance of sustainable supply chain in the fast fashion industry	The density of supply chain, the complexity of the transaction, the centrality of the focal company, capabilities of suppliers, regulatory capacity of government, the capacity of disclosure by NGO's, characteristics of customer demand	Internal and external perspective	Fashion industry
6	Payman Ali, Cory Searcy (2014)	Analysis of metrics in green and sustainable supply chain	Identified 76 indicators	Identified thirteen different perspectives in the sustainable supply chain	Literature Review
7	Gopal and Thakkar (2015)	Sustainable supply chain practices in Indian automobile industry	Selected 11 indicators	Environmental, social and economic	Automobile
8	Gunther et al. (2014)	The role of electric vehicles for sustainable supply chain in the automobile industry	Selected eight factors	Economic, social and environmental	Automobile industry
9	Govindan et al. (2014)	Barriers analysis for green supply chain in Indian industries	Identified 47 barriers and classified under outsourcing, technology, knowledge, financial and investment & support	Environmental and economic	Indian Industries
10	Thun& Muller (2010)	An empirical investigation of the status quo of German automobile industry	Identified the key factors in automobile industry	Environmental, social and economic	German automobile industry
11	Seciring and Muller (2008)	A conceptual framework for sustainable supply chain management	Find various factors to analyze the dominating perspective	Identified environmental aspects are dominating than social	Literature review
12	Hassini et al. (2012)	Sustainable supply chain study with a focus on metrics	Study focus on metrics	Classified the papers as per industry of the study and firm size.	Literature review
13	Zhu, Sarkis and Lai (2014)	Pressure, performance and practices in the green supply chain of Chinese automobile industry	Identified the environmental and operational and economic performance factors	Environmental, operational and economic factors	Chinese automobile industry

Secring and Muller (2008) reviewed all the major papers published up to 2007 and confirmed that the major dominating areas are green/ environmental issues. Later Hassini

et al. (2012) reviewed the supply chain literature up to 2010 and classified the papers as per the industry of the study and firm size.

Luthra, D Garg and Haleem (2015) analyzed the key success factors behind achievement of environmental sustainability in Indian automobile industry supply chains. They identified the key success factors as internal management, customer management, regulations, supplier management, social, and competitiveness. They extracted four performance measures as economic, social, operational and environmental. Giannakis and Papadopoulos (2015) has done the exploratory empirical case studies on textile manufacturing companies and found that environmental risks are perceived to be the most important across different industries.

Grimm et al. (2014) studied the critical factors that help to overcome the complexities and unique challenges of sub-supplier management with a focus on the food industry. They identified 14 critical success factors, compliance with corporate sustainability standards. Cambero and Sowlati (2014) presented a review of studies that assessed or optimized economic, social and environmental aspects of forest biomass supply chains for the production of bioenergy and bioproducts.

Yongjan Li et al. (2014) analyzed the motives for adopting sustainability governance in fast fashion supply chain and identified seven sustainable competitive attributes of the fast fashion produced based on sustainable development theory. The factors are the density of supply chain, the complexity of the transaction, the centrality of the focal company, capabilities of suppliers, regulatory capacity of government, the capacity of disclosure by NGO's and characteristics of customer demand. Ali and Searcy (2014) identified a large number of metrics from the articles published up to 2012 and classified under 13 key perspectives of sustainable supply chain management drawn from the literature. They identified 76 indicators which are classified under thirteen key perspectives which are the economic focus, environmental focus, social focus, volunteer focus, resilience focus, long-term focus, stakeholder focus, flow focus, coordination focus, relationship focus, value focus, efficiency focus, and performance focus.

Gopal and Thakkar (2015) analyzed the relationship between environmental, social and economic performances of the sustainable supply chain performance of the Indian

automobile industry. They selected 11 indicators for the measurement of performance of the supply chain which are operating cost, total sales, employee usages and benefits, economic value retained, reduction in energy consumption, reduction in resource consumption, reduction in greenhouse gas emission, reduction of solid waste, reduction of solid waste, child labor, employee's wellbeing and training & education.

Govindan et al. (2014) identified the barriers to the implementation of a green supply chain management based on procurement effectiveness. They identified 47 barriers and classified them under outsourcing, technology, knowledge, financial, and investment and support with environmental and economic perspectives. Thun and Muller (2010) also carried out an empirical investigation to find out the status quo of the green supply chain management in the German automotive industry.

From the literature study, it is found that the factors selected for the empirical study of various industries and sectors are different and that depends upon the nature of the industry or organization. The perspectives of the studies are also different in different sectors. However, the majority of the studies are concentrated in the environmental, economic and social aspects of the sustainability.

2.12 CONCLUSION

Existing literature on the supply chain performance, status of ornamental fish supply chain in India, Supply chain risk management, marketing and promotional strategies for the ornamental fish supply chain, sustainability studies in various sectors are reviewed in this chapter. The ornamental fish supply chain has risks that need to be identified and suitable performance measures that need to be put in place. The promotional strategies and sustainability factors are required to be determined to effectively perform and manage the supply chain for improving the ornamental fish supply chain in India.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This chapter describes the research methodology, development of the conceptual model, research design, questionnaire development and its administration which includes target respondents, sampling technique, the pilot study incorporated and data collection methods. Further, it briefly describes the tools of analysis used in this research.

The initial review of literature and business environment in the state of Kerala related to ornamental fish business and supply chain helped to identify a research gap on the ornamental fish supply chain. After the detailed study of the literature on supply chain management, supply chain risk management, marketing management and sustainability assessment along with the study of the ornamental fish supply chain the design of research carried out. The discussions with the researchers and experts from the Department of Industrial Fisheries, Cochin University of Science and Technology also helped in carrying out this research work.

3.2 Research Design

The design of this research has two major phases namely the descriptive research design and Ex-post-facto research design. In Phase 1- Descriptive Research Design, a conceptual model was developed covering the different dimensions of the study.In Phase II – Cause-effect based Ex-post-facto research design was used. The term ex-post-facto according to Landman (1988) is used to refer to a study that attempts to discover the pre-existing casual conditions.

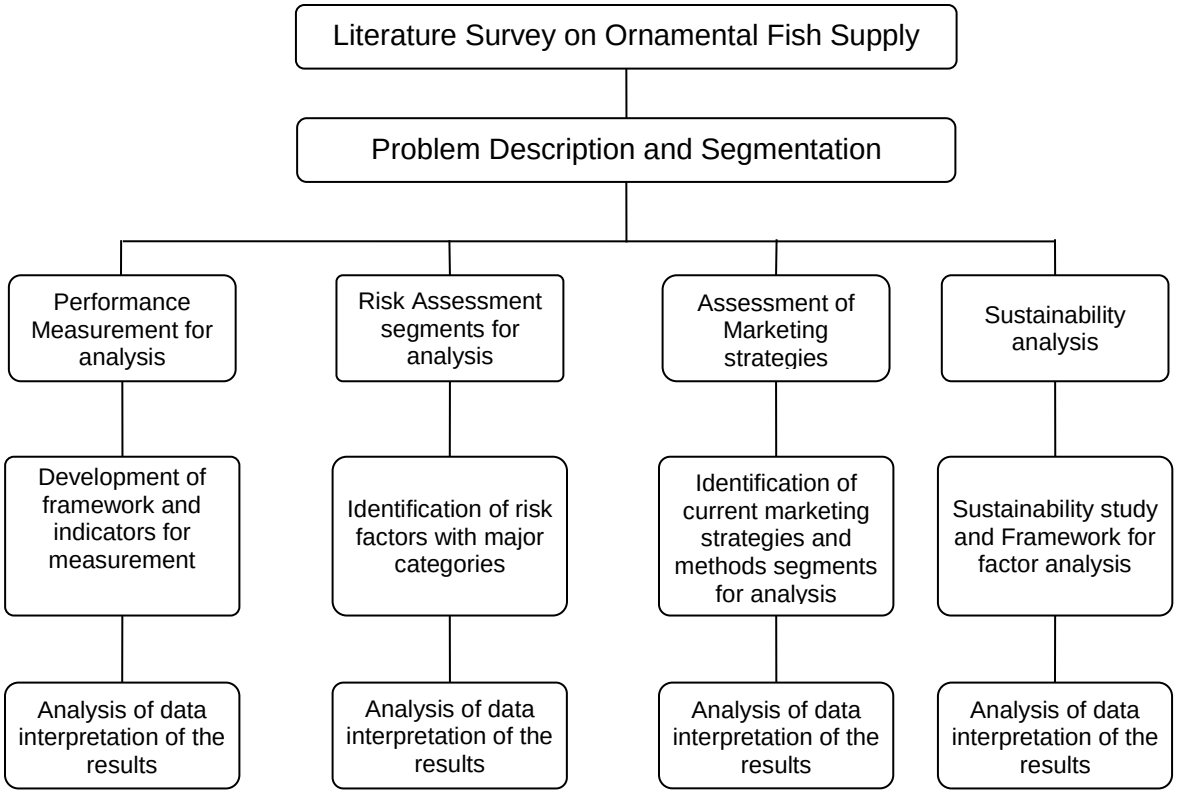


Fig 3.1: Description of Research Methodology

The methodology adopted for conducting research is explained in figure 3.1. As shown in the figure initially research gaps were identified by conducting a review of literature of ornamental fish supply chain and supply chain management related to the ornamental fish sector. Subsequently, the ornamental fish supply chain and its members were identified and broke down into segments for the proper analysis. Frameworks and methods for performance analysis, risk assessment, marketing analysis and sustainability assessment are designed. Techniques like questionnaire, interviews and literature search are used to collect data which are analyzed statistically. The results of the analysis are interpreted to derive conclusions and future scope of the business.

3.3 DATA SOURCES

Primary as well as secondary data sources have been used in this research study. The primary data for this study have been collected from the supply chain members of the ornamental fish supply chain from 36 small towns of Kerala state of India. Various studies pursued from Center Marine Fisheries Research Institute (CMFRI) and Department of

fisheries of Cochin University of Science and Technology were considered. National and international journals were also referred for getting more insight into the research.

3.4 CONCEPTUAL MODEL DEVELOPMENT

The research work on Ornamental fish supply chain is carried out by developing models for ornamental fish Supply chain performance measurement, ornamental fish supply chain risk assessment, assessment of marketing strategies of Ornamental fish and assessment of sustainability practices in ornamental fish business and the effect of adoption of green certification programme in the ornamental fish supply chain by MPEDA. These models are developed with constructs and standard variables that are available in the literature and specific variables of the ornamental fish supply chain. The formulation of the models and definitions of the variables involved are described in the succeeding sections.

3.4.1 Framework for the Ornamental Fish Supply Chain Performance Measurement

Based on existing supply chain performance indicators, a conceptual framework for measuring the performance of the ornamental fish supply chain has been developed. Indicators that are related to the ornamental fish supply chain are selected according to the suitability based on discussions with experts in this field. These performance indicators are grouped into four categories namely Flexibility, Quality, Customer Service and Finance and Marketing. The categories and indicators included in the categories are shown in Figure 3.2. These categories and the indicators grouped into these categories are explained in the succeeding paragraphs.

3.4.1.1 Flexibility

Flexibility is the degree to which supply chain can respond to a change in environment and extraordinary customer service request (Beamon, 1998). The need for flexibility originates from customers. Flexibility in variety, quality, competitive prices and faster delivery are requirements of the customers. This has forced companies to respond faster to customer needs in order to sustain the competitive advantage of the organization. As a result, the companies need to be flexible enough to react to changes in customer

demands (Aggarwal, 1997). Flexibility is regarded as a critical factor by which supply chains become competitive. In the ornamental fish supply chain, flexibility is achieved through order flexibility, delivery flexibility, customer service flexibility, accuracy in forecasting the demand and back orders.

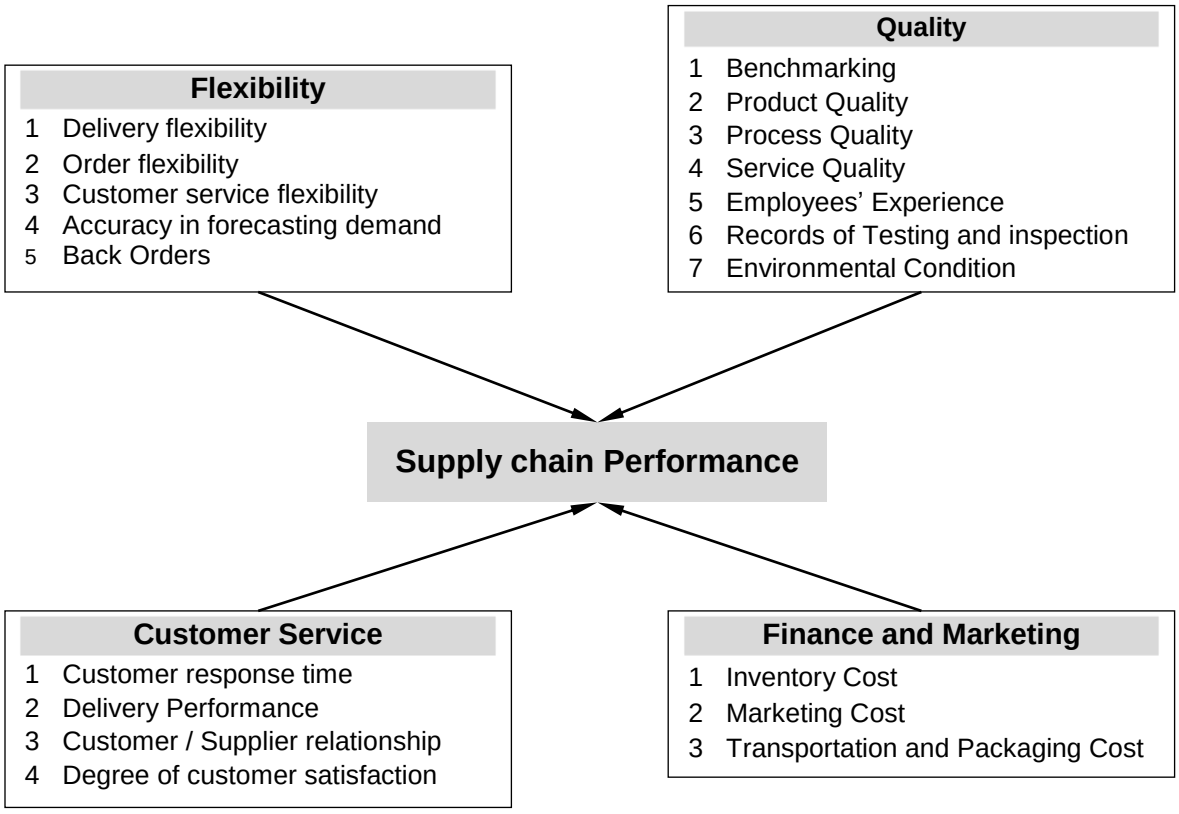


Figure 3.2Categories and Indicators of Ornamental Fish Supply Chain Performance

1. **Delivery Flexibility**

Delivery flexibility refers to the flexibility in meeting a particular customer delivery requirement at an agreed place, agreed mode of delivery with an agreed upon customized packaging. This type of flexibility can influence the decision of customers to place orders, and this is important in achieving and retaining customers (Novich 1990, Gunasekaran et al., 2004). Delivery flexibility is the company's capability to adapt to lead times of the customer requirements. An example of high delivery flexibility is Just In Time when suppliers deliver the products to the customer at the right quantity, place and time. Delivery flexibility is important in the ornamental fish supply chain as it

requires special packaging and transportation. The place of delivery is also important in the ornamental fish supply chain.

2. **Order Flexibility**

Order flexibility or Volume flexibility is the ability to change the volume of the product as per the variance in demand in any period. Volume flexibility is "the ability to effectively increase or decrease aggregate production in response to customer demand" (Cleveland et al. 1989). In the face of increasing demand, volume flexibility may require close coordination between a breeder & its suppliers. Volume flexibility directly impacts on the performance of the ornamental fish supply chain by preventing out-of-stock conditions of products that are suddenly in high demand by preventing high inventory levels.

3. **Customer Service Flexibility**

It is an indication of how fast a product can be delivered to the customer site and how much flexibility is possible concerning time and place. Delivery at the customer site is important in the ornamental fish trade as it requires special equipment's to carry fish along with water and accessories. In respect to the ornamental fish supply chain, customer service flexibility refers to the ability of the supply chain member to deliver the product as per the customer request at the specified time and place.

4. **Accuracy in Forecasting Demand**

Forecasting is the process of developing long-term estimates of expected demand by using historical demand data. High demand forecast error has a detrimental impact on supply chain performance resulting in lost sales, obsolete inventory, and insufficient utilization of resources. Accuracy in the forecast estimation is essential. If the aggregate forecasts are more accurate, the forecast accuracy will be improved. Proper balancing of supply and demand of the ornamental fishes are essential for minimizing total production, transportation, and inventory costs and to maximize the profits. Hence the accuracy in the demand calculation is an important factor in the flexibility measurement of the ornamental fish supply chain.

5. **Backorder**

Backorder is an order that is currently not in hand but is being reordered and will be available at a later time provided the customer is willing to wait until supply arrives. It can be measured as the proportion of the total number of back orders to the total number of orders. Ornamental fish suppliers will be able to fulfill demand at a later point in time if the customers are ready to wait. It is an important factor in measuring the performance of ornamental fish supply chain.

3.5.1.2 Quality

Quality is an elusive and indistinct construct. Often mistaken for imprecise adjectives like goodness or luxury or polishes or weight (Crosby 1979). The attainment of quality in products and services has become a central concern (Parasuraman et al. 1985). Here in the ornamental fish supply chain, the indicators quality and employee satisfaction are grouped and addressed as quality. It includes benchmarking, product and process quality, service quality, employee's experience, records of all inspections and tests, sustainability and environmental considerations.

1. Benchmarking

Benchmarking constitutes the attempt to ensure the superiority of a particular activity through the adoption of better performance methods. It involves a continues comparison of processes, products, and services featuring similar activities that all are deemed to be the best in class (Balm 1992). In benchmarking the adoption of the guidelines in the green certification programme for Ornamental fish trade developed by the Marine product Export Development Authority of India (MPEDA) by the retailers, wholesalers or breeders are also included.

Green certification ensures product quality, safety, and traceability and it is given to a product that ensures it's environmental and socio-economic sustainability. The vision of the certification programme is the "conservation and sustainable development of freshwater ornamental fish sector involving collection farming and marketing through a value chain system enabling certification at all stages." No studies are reported on the effect of the green certification launched in 2008 by MPEDA. As the first step in this direction, this study tried to check the awareness about the certification

programme among the traders as the specific characteristics for the ornamental fish supply chain.

2. Product Quality

Product quality is significant for the performance of the supply chain. Quality of the product depends on many factors. The purity of bread and health of the fish siblings are essential factors that determine the quality. The product should have completely equivalence with the features of ideal products on the size, color, and weight to ensure the quality.

3. Process Quality

In order to improve the process quality, the various process, technology to adopt the process scientifically and tasks being performed need to be identified and documented. Customers, their requirements, expectations, and perceptions also need to be identified (Beamon and Ware 1998).

Farming of the ornamental fish needs to be planned and practiced in an environmentally responsible manner for improving the quality of the process. Proper breeding and farming have an impact on the quality variables such as biodiversity, habitats, and ecosystems. To maintain the quality, the feeds, feed additives, manure, and fertilizer should be used responsibly.

4. Service Quality

Delivering quality service is considered as an essential strategy for the success and survival in today's competitive environment (Dawkins and Reichheld 1990). The delivery of higher levels of service quality is the strategy that is increasingly being offered as a key effort to position effectively in the marketplace (Brown and Swartz 1989). Here in this indicator measures the quality of services adopted in retailing and offered the customers at the time of purchasing the items. Service quality is more critical in the ornamental fish supply chain as well. Helping customers to choose the proper species, providing information on the prescription and health aspects of the fish keeping are some of the steps that improve the sense of quality.

5. Employees Experience

Experiences enter the accumulation of job-specific knowledge from action, practice, and perception of the tasks and duties associated with a specific job (Quinones et al. 1995). Based on perceptions and practice, the experience is inherently tied to time, whose passage allows for the accumulation of the job-related knowledge. Human capital theory suggests experience investment itself enhance the ability of the employer and thus influence job performance (Ehrenberg & Smith 2000). Job performance changes over time because individuals accumulate job experience. Experience in a particular job will increase relevant knowledge, skills, and abilities (Campbell 1990).

Employees in the ornamental fish supply chain business have to have enough experience in this field about the day to day process requirements; common deceses and its symptoms, common drugs required for various species, the behavior of various ornamental fish species and the facilities required. Employees should have good knowledge and experience at the time of collection, method of collection, the process of carrying fish during collection in order to maintain the quality of the fish.

6. Records of Testing and Inspections

It is mandatory to have proper documentation of all events and activities as well as maintenance of the data for verification and future use. There should be appropriate documents on the collection of fishes, handling and transportation of ornamental fishes, health status, packaging materials used, mode, time and duration of transportation, mortality rate, species, number, size received and sold, health status, treatment used, mortality in the holding facility, date of receiving and dispatch etc.

7. Environmental Conditions

Organizations attempting to integrate a sustainability approach into their activities and strategies extend more care towards the environmental issues. A sustainable supply chain will improve the social, environmental and economic impact of the raw material and service flows and link supplier, manufacturers and end users. Environmentally alert consumers and society compels organizations for efficiently incorporating ecological apprehensions along with their organizational and managerial practices (Zhu et al. 2008).

The environmental impact of ornamental fish trade is of considerable importance. Lack of adequate resources and mechanisms for reef conservation, due to the extractive nature of the fish collection in the developing countries has severe impacts upon the ecosystem. Even though this has adverse effects on the marine fish trading, the trade ultimately disadvantages the environment and the communities where fish collection occurs.

Increased concern on environmental protection among the modern customers has created greater consumer preferences for companies and products with minimal environmental impacts (Wynce 1994). Consumer's insistence on products with low environmental impacts and use of products that are produced and distributed in an environmentally friendly manner influence the eco-certification programmes (Tiels 2001).

The constitution of the marine stewardship council (MSC) in 1996 gained momentum in the use of certification as a management tool. The system encompasses any organization that processes, wholesales or retails the certified product (Potta and Harward 2005). The system is now expanding and garnering increased support from fishing related industries, government, and NGOs. The growth reflects the increasing consumer acceptance of the certification system.

Even though there are no such types of certification available in the ornamental fish trade of Kerala, understanding the environmental consideration of the traders, retailers, and wholesalers in selecting products, processes, and materials used are important. The supply chain members for the collection, fishing, holding and handling of ornamental fish need to be environmentally friendly. Trading fish varieties, which are harmful to the ecosystem or other fish verities, selling of the fish varieties which are very rare and abandoned by the international bodies and governments are some of the activities that cause an adverse effect to the environmental considerations.

3.5.1.3 Customer Service

Customer service has a vital role in improving the performance of the supply chain (Lummus et al. 2001). For an effective supply chain, each of the elements has to satisfy the

expectations of the customer. Satisfactions of the customer are of utmost importance in a world-class organization. Without a contented customer, the supply chain strategy cannot be deemed adequate. It can be measured as the percentage of satisfied customers to the unsatisfied customers. (Lee and Billington 1992, Van Hoek et al. 2001). According to Gunasekaran and Tirtiriglu (2001), better supply chain customer service is the fulfillment of an organizational objective through supply chain management.

In ornamental fish sector also customers are expecting valuable service. Customer service measurement includes customer response time (delivery timeliness or lead time gap), delivery performance, customer relationship and degree of customer satisfaction

1. Customer Response

In the current market, customers in almost all supply chains can enquire about the status of the order, potential problems on stock availability or delivery. For keeping customers satisfied, fast and accurate response to those requests is essential. Customer response relates to the time taken for a firm to respond for a customer query with the required information

2. Delivery performance

On time delivery reflects whether perfect delivery has taken place or not. It is a measure of customer service level. Increasing delivery performance is possible through a reduction in lead time attributes (Stewart 1995, Christopher 1992, Gunasekaran 2004). The measurement of delivery performance can be based on order compliance, data of shipping errors, the percentage of the perfect order delivered and with product lateness.

3. Customer/ Supplier Relationship

Relationship with suppliers and strategies used for maintaining this relationship is significant in the supply chain (Wisher 2003, Ferry et al. 2015)). Relationships with an intention that the arrangement is not going to be temporary will lead to long-term relationships (Chen and Paulraj 2004). For successful performance and improvement of supply chains, strategic alliance and integrated relationship with suppliers and buyers are very much needed. The major characteristics in a relationship

involve trust, loyalty, positive-sum game (a win-win relationship), cross-functional teams, achieving common goals and collaboration (Chandra and Kumar 2000). The good relationship with the ornamental fish supply chain partners could result in increasing the revenue. The success of a member is linked with its strength in the relationship with the other supply chain partners.

4. Degree of Customer Satisfaction

According to Philip Kotler “Customer satisfaction is defined as the personal feeling of pleasure resulting from comparing products and perceived performance about expectations.” Customers always assess the quality of the product, value, performance and special features which they keep in their mind and reflect on their purchases. So customer satisfaction is crucial to every business. It is the responsibility of business firms to keep the customer satisfied at all times. Delivery of the product is the link in the ornamental fish supply chain that directly impacts customers. It is a primary determinant of customer satisfaction. Measuring and improving delivery is always desirable to increase business performance.

3.5.1.4 Finance and Marketing

Three factors are included in the finance and marketing category of the ornamental fish supply chain. It is a measure of how well the resources are utilized. Inventory cost, costs related to marketing and transportation costs are the measures of supply chain performance in this category.

1. Inventory Cost

The technical definition of inventory means the firm’s merchandise, raw materials and finished and unfinished materials which have not yet been sold.The ornamental fish sector has higher feed requirements similar to the food fish sector. Many ornamental growers felt that feed cost had a significant impact on the performance of the ornamental fish supply chain operations. For large scale aquaculture, food and labor are typically among the largest operating costs. (Kam et al., 2003). Cost of holding the live species also more compared to other products.

2. Marketing Cost

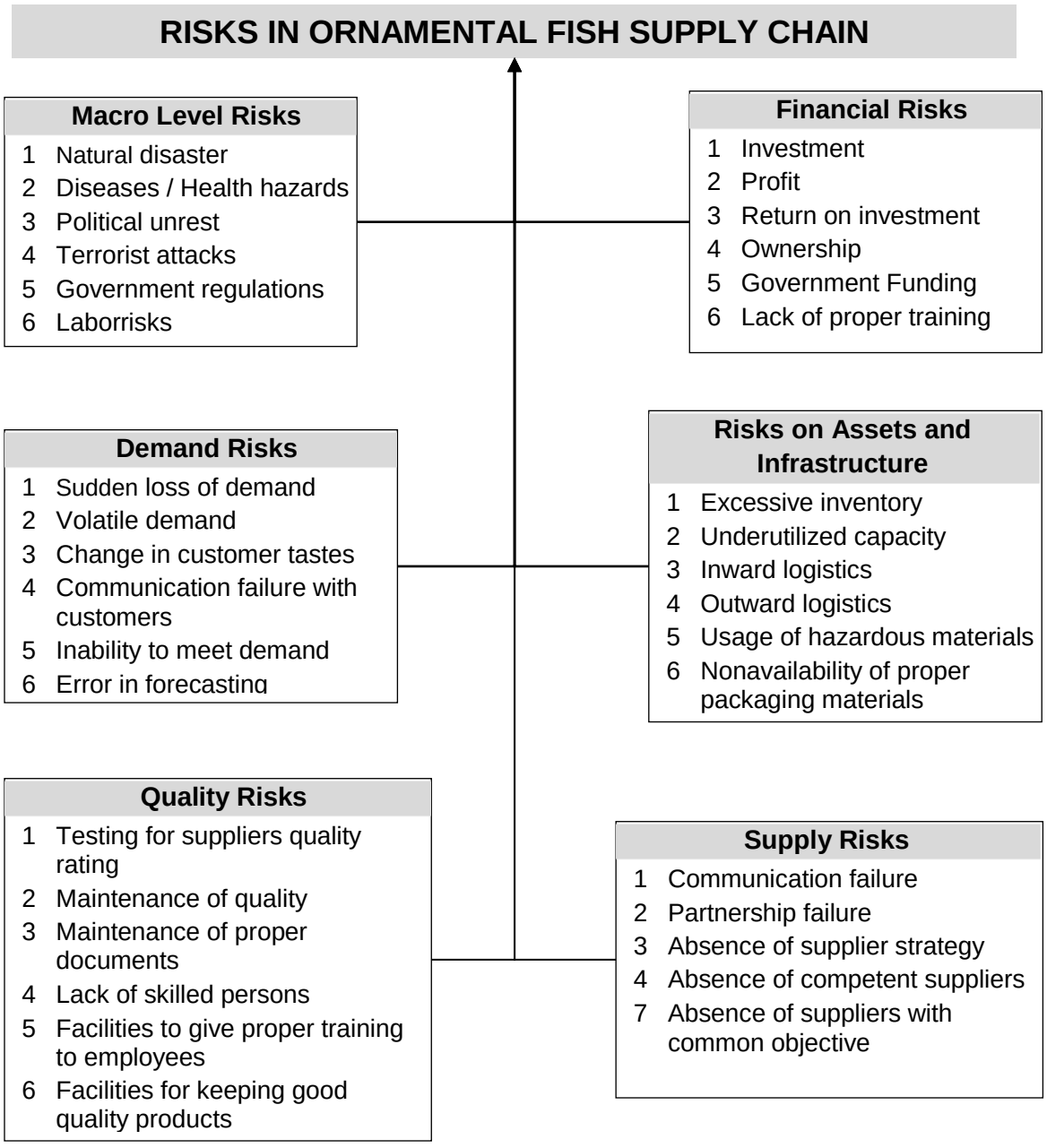
Activities undertaken to increase sales are grouped under the marketing category, and the costs associated with these activities are termed as marketing cost. Type of methods adopted for the marketing of ornamental fish differs among supply chain members. The market studies on the ornamental fishes are significant to evaluate the demand, supply, profitability and the species diversity in the field (Nath et al., 2010). Hence marketing research is required for improving the performance of ornamental fishes business in Kerala. Lack of sufficient facilities and infrastructure for marketing are the serious obstacles to efficient distribution (Sekharan 2006).

3. Transportation and Packaging Cost

Without efficient transport including good and reliable logistics, the modern ornamental fish trade would not exist. Transporting tropical animals is a task which demands special skills and experience in handling unforeseen problems. The professional ornamental fish trader has to consider transporters as their best partners and keep a good relationship with them to maintain the supply chain as reliable as possible.

3.5.2 Framework for the Ornamental Fish Supply Chain Risk assessment

This section describes the framework developed on the supply chain risk and risk management strategies of ornamental fishes with a specific focus on Kerala a state of India and to identify the risks involved in the supply chain operations. Ornamental fish supply chain being different from other supply chains, risks specified to this included in six categories. The risks are categorized into macro-level risks, demand-side risk, supply risk, quality risk, risk on asset and infrastructure and financial risk. The categories and various risks coming under each category are as shown in Figure 3.3.



3.5.2.1 Macro level Risk

The macro level risk comprises of the external uncertainties arising from the supply chain or social uncertainties. Papadakis and Ziemba (2001) have discussed the financial consequences of the natural hazards in global supply chains and alternative supply chain models. Natural disasters do not come announced and are not very uncommon in nowadays. So a well-organized supply chain required preparedness and preplanning for its

proper delivery and supply. Political uncertainties in different countries at different periods are increasingly affecting supply chains (Kleindorfer and Van Wassenhove 2004). The problems outside the supply chain such as socio-political, economic, technological, or geographical problems may lead directly or indirectly to disturbances within the supply chain (Kleindorfer and Saad 2005).

Hence in the macro level risk category risks due to natural disaster, diseases/health hazards, Political unrest, terrorist attacks, government regulations and labor risks are included. These risks are inherently unpredictable, and firms want to return to normal operations as soon as possible. Bosman (2006) makes the point that organizations quickly target or underestimate how damaging these events are. The fact is that the disasters are very unlikely to happen and the probability of occurrence of that, do not even register as an anticipated risk. Deloitte (2005) found that many of the greatest losses in market capitalization were attributed to events that were considered extremely unlikely and for which companies had failed to plan. The combination of low probability and high consequences gives emergencies a low expected value, but they are of considerable importance.

The external events that effects on supply chains and the companies involved in it are addressed with numerous articles (Chopra and Sodhi 2004). The consequences of catastrophes especially augmented the attention to risks in supply chains over the last years. In the US Ford and Toyota had to reduce their production in their manufacturing plants due to significant delays in delivery of parts coming from foreign countries (Sheffi 2001). Financial losses, a negative corporate image or a bad reputation eventually accompanied by a loss in demand as well as damages in security and wealth are the consequences of supply chain disruptions (Juttner et al. 2003). Hendricks and Singhl (2005) carried out the study on the effects of supply chain disruptions on stock prices and equity risks based on the 827 disruption announcements samples. They concluded that firms do not recover quickly from the adverse effects of disruptions.

A global supply chain is subjected to socio-political risks when multiple countries are involved. Terrorist attacks in the US and many Asian and European countries, motivated the researchers to redefine the risk issues for business continuity and devise a mechanism for quick recovery after the disruption.

3.5.2.2 Demand Risk

Demand risk is the risk associated with the demand of the product which can be caused either by inbound disruptions like seasonality, volatility of the market, new product adoption or by short product life cycles (Johnson 2001). Sources of supply and demand risk sources are specific for different supply chains. Demand volume unpredictability is one of the significant problems of organizations. Demand risk encompasses uncertainties in both volume and mix (Tang and Tomlin 2008, Kopczak and Lee 1993). Demand risk can originate from the uncertain surroundings and the random demands of the customers (Nagurney et al. 2005). The uncertainties regarding demand forecast might result in delivery bottlenecks, high inventories or inefficient capacity utilization (Cachon and Lariviere 2001), apart from the sudden loss of demand. Due to uncertain demand, companies may face the problem of overstocking of certain varieties at one region and under stocking varieties in another area. Demand risks include volatile demand, error in forecasting demand, change in customer taste, communication failure with customer and inability to meet demand.

Forrester (1961) described the ‘bullwhip effect,' where risk is amplified as it moves through a supply chain. When the information on demand travels through the supply chain, a relatively small change in final demand is amplified into a major variation for upstream suppliers. Christopher et al. (2002) say that these effects are a result of ‘overreactions'; unnecessary interventions, second-guessing, mistrust, and distorted information throughout a supply chain.

3.5.2.3 Supply Risks

Supply risk is the uncertainty associated with the supplier activities and supplier relationships in general (Juttner 2005). Organizations are exposed to numerous risks associated with their suppliers and supply networks. To keep supply cost down and to alter the order quantity different companies are adopting different strategies (Lee 2004). Supply risks are concerned with the "upstream" activities in the supply chain (Zsidisin 2003). Financial instability of the suppliers and suppliers incapability to adopt new technologies for product development may lead to supplier risks and losses to the company (Zsidicine et al. 2000, Wagner and Johnson 2004). Financial instability of the direct competitor of the customer firm (Chopra and Sodhi2004), the opportunistic behavior of the suppliers

(Spekman and Davis 2004) and capacity constraints are related risks associated with suppliers.

The significant risks considered for the analysis of supply risks are communication failure, partnership failure, the absence of supplier strategy, the absence of competent suppliers and absence of suppliers with the common objectives. Supplier selection criteria are reasonably consistent across the supply chains and commitment to establish a long-term cooperative relationship is an important selection criterion. Price is one of the least important criteria, while quality and delivery are essential criteria.

The absence of supplier strategy is an organizational risk category, and this risk. A good supplier strategy arises from the links between members of the supply chain relationship between suppliers and customers, alliances and shared benefits. The supply risks arise as a result of poor communications, lost customers, problems with suppliers, disagreements over contracts and legal disputes. These types of risks affect an individual business or supply chain, typically reducing its market share and income.

Most of the United States manufactures reduced the number of direct suppliers throughout the late 1980s and early 1990sto cut the cost of managing multiple suppliers and to adopt better supplier relationships. Some companies even pushed for sole sourcing. By measuring the performance a small number of suppliers is more efficient, but it will increase supply risks.

3.5.2.4 Quality Risks

Risks associated with the quality of the product, procedures for the proper quality maintenance come under the quality risk category. The risk categories under this classification are testing for supplier's quality rating, maintenance of quality, maintenance of proper documents, lack of skilled persons, facilities for keeping good quality products and facilities to give proper training for employees. To improve the quality and capabilities firms have to invest heavily over the past decade in programmes such as Total Quality Management (TQM), Lean Manufacturing and Six Sigma.

3.5.2.5 Risks on assets and infrastructure

Risks on assets and infrastructure often result in increased inventory cost due to the obsolescence of the product, markdown or stock-outs which are passed on among the organizations in the supply chain (Juttner and Christopher 2003). Risks included in this category include excessive inventory, underutilized capacity, inbound logistics, outward logistics, usage of hazardous materials, and non-availability of proper packaging materials.

3.5.2.6 Financial Risks

Financial risks have a significant adverse effect on the profitability of the supply chain (Hendricks and Singhal 2003 and 2005). Lack of ownership risk sources in the supply chain, result from blurring boundaries between buying and supplying companies in the chain. The vulnerability of the financial strength of the supply chain member affects the entire supply chain network (Peck et al. 2003, Tang 2006b). The factors included in this category are the risks on investment, profit return on investment (ROI), ownership, government regulations and lack of proper training.

3.5.3 Marketing Schemes

In this section, the study seeks insight into the prospects of marketing strategies in the ornamental fish sector of Kerala in order to find out the possible ways of increasing the trade. To penetrate into the domestic market, consumer-oriented marketing strategies have to be followed.

Two aspects of the ornamental fish trade need to be studied to analyze the marketing strategies of the ornamental fish supply chain. Primary data on the trade information about the number of verities trading in the firms, weekly turnover of the firms and the profit share from various segments of the ornamental fish trade like packaging materials, preparation of aquarium and sales of accessories need to be collected. After this the types of promotional schemes and promotional offers by the traders, and the marketing schemes need to be identified.

3.5.3.1 Promotional Schemes and Offers

Promotion is a way where the sellers communicate with their customers, and it is also a way to attract the customers. Pauline and Philippe (2012) are of the opinion that sales promotion can improve customer efficiency during the purchase by reducing search costs. Sales promotion techniques are instruments that seek to increase sales of products and brands usually in a short time (Wierenga and Soethoudt, 2010) because they act in a consumers mind as a benefit to him, creating thus consumer behavior (Yusuf, 2010). It is believed that sales promotion has a positive influence on the purchase intention. According to the studies of Capbell and Diamond (1990) and D, Astous and Landreville (2003), sales promotion are distributed into two groups; price or monitory promotion (discounts, coupons, rebates); non-monetary promotions not geared to price (free samples, distribution of promotional prices, gifts, contests and loyalty programmes.

Investigation on the usage of various promotional schemes and its analysis will give insight to the number of ornamental fish supply chain traders. TV advertisement, Newspaper advertisement, Advertisements through new media like WhatsApp and Facebook, Notices and visiting cards are the generally promotional schemes used by them. Sales promotion activities include multiple offers like the discount sale, door delivery, free maintenance of equipments and accessories and replacement of death items.

3.5.4 Sustainability Practices in Ornamental fish Supply Chain

In order to identify the sustainability practices adopted by the ornamental fish supply chain, variables that come under environmental, social or economic pillars of sustainability are identified. From the previous works on supply chains and ornamental fish supply chain,16 variables identified. The definitions and importance of the variables explained in the succeeding sections. These variables are illustrated in Table 3.1.

3.5.4.1 Green Certification Programme

Certification schemes are being proposed to counter the issues arising from unsustainable fishing practices (Jacquet and Pauly 2007). There are mixed responses on whether certification is required or not (Tlusty, Dowd and Von Halle 2006). Outline for Green

Certification of ornamental fishes in India (Silas et al. 2011) is developed by Marine Product Export Development Authority of India (MPEDA) under the ministry of commerce and industry, Government of India. The Green Certificate will give an assurance that the fish has been caught/produced/reared in a manner which ensures that the social and environmental sustainability and certifies its supreme quality regards to health and biosecurity issues.

Green certification programme is the first of its kind in the ornamental fish sector (Jayalal and Ramachandran 2012), which helps to maintain the environmental and socio-economic sustainability. The approach in the green certification programme, ensure the principles of ecosystem management in the fish collection and trying to reduce the dependence on wild stocks (Silas et al. 2011). Green certification can be a strategy for improved marketing in addition to ensure sustainable harvest. Priyanga et al. (2016) listed the gaps in information in the green certification programme, which is developed to ensure the sustainable harvest of the freshwater fishes to ensure the sustainability practices. Even though the green certification programme has only a peripheral aim to ensure the sustainability, it is highly essential to check the awareness of green certification programme and its procedure within the members of the ornamental fish traders.

3.5.4.2 Customer Complaints

A mechanism for receiving all type of customer related queries are fundamental in the current business environment. In this variable, it is checking whether the firms have any permanent mechanism for receiving customer complaints.

3.5.4.3 Environmental Friendly Products

The result spur in “green consumerism” has involved greater consumer preferences for companies and products with minimal environmental impacts (Wynce 1994). Eco-certification programmes influence consumers to reduce the environmental impacts of their consumption by purchasing only those products that are produced and distributed in an environmentally friendly manner (Tiels 2001).

3.5.4.4 Alien Species

Due to socio-economic and livelihood benefits, the ornamental fish industry is viewed positively while due to overharvesting, habitat destruction, alien species invasion it is also negatively influenced (Watson and Morean 2006).

3.5.4.5 Environmental Friendly Materials

The pressure from customer and government regulations cause the firms to be careful about the products and their environmental impacts. The material they are using for their production and inventory related activities should also be environmentally friendly. It is the attitude and sincerity of the supply chain members who decide on how they behave towards the protection of the environment and the ecosystem.

Table 3.1: Selected sustainability variables and their definition/ importance

Sl No	Sustainability Variable	Definition / Importance of the factor
1.	Green certification programme	To check whether the members are adopting scientific procedures prescribed by the green certification programme
2.	Customer complaints	Mechanisms for receiving customer complaints
3.	Environmental friendly products	Do business with environmentally friendly products
4.	Alien species	Care towards the insertion of alien species which cause adverse impacts on the ecosystem
5.	Environmental friendly materials	Care towards the usage of materials which cause the negative impact on the environment
6.	Quality of the product	Maintenance of quality of the product
7.	Scientific methods	Adoption of scientific methods in all the day to day process
8.	Training programme	Establishing policies and positive attitudes toward the workers to improve their quality
9.	Records of testing and inspections	Maintaining the documents related to regular tests and inspections from the authorities
10.	Environmental issues	Supply chain members approach towards environmental issues
11.	Supplier relationship	Relationship with suppliers and buyers
12.	Measure of customer satisfaction	Whether the members are adopting any techniques to measure the customer satisfaction
13.	Degree of customer satisfaction	Measurement of the approximate level of satisfied customers
14.	Marketing	Members using any marketing activities to improve their trade/ business
15.	Competition	Check whether the firms or supply chain members feel any competition from the market

16.	Customer service	Strategies to make customers more satisfied.

3.5.4.6 Quality of the Product

Quality of a product or service refers to the perception of the degree to which the product or service meets the customer's expectations. In the ornamental fish sector the quality of the fish defined with its external features like color, weight, length, preservation and breed. Factors typical to the ornamental fish supply chain that affect the quality are to be identified and improved. One such example is the use of sodium cyanide. Ornamental fish captured with sodium cyanide that has rapid narcotic effect die after five months due to liver damage caused by cyanide.

3.5.4.7 Scientific Methods

The scientific method is the best way yet to discover for doing one particular process. The development of scientific method involves some of the most enlightened cultures of history. In the case of the ornamental fish supply chain from the breeding stage to the delivery to the customer it undergoes various processes. For all the concerned process there should be related scientific process and rules. By this variable, it is possible to check the supply chain member's readiness towards the scientific prescriptions. It is the measurement of adaptation of the scientific methods of the firm for all their day to day process.

3.5.4.8 Training Programmes

Human capital theory suggests that employees make investments of experience in themselves which enhance their ability and thus influence job performance (Ehrenberg & Smith 2000). As per this perspective, individuals accumulate job experience and their performance in the particular job category increases as per the experience. It also leads to the accumulation of relevant knowledge about the types of skills and abilities required and everything related to maintaining the quality of the product (Campbell 1990).

As a particular supply chain, employees in the ornamental fish sector require specialized training for their activities. By analyzing this variable, we are trying to check the

firm’s policies and attitudes towards improving the skills and qualifications of their employees.

3.5.4.9 Records of Testing and Inspections

It is mandatory to have proper documentation of all events and activities as well as maintenance of the data for verification and future use. There should be proper documents collection of fishes, handling and transportation of ornamental fishes, health status, packaging materials used, mode, time and duration of transportation, mortality rate, species, number, size received and sold, health status, treatment used, mortality in the holding facility, date of receiving and dispatch to customers.

3.5.4.10 Environmental Issues

Environmental issues have become a key concern for companies as most of them integrate a sustainability approach into their activities and strategies. Increased strain from society as well as from consumers who are environmentally alert compels industrialist for efficiently incorporating systems for reducing ecological apprehensions on its organizational managerial practices (Zhu et al. 2008).

The environmental impact of ornamental fish trade is of considerable importance. Lack of adequate resources and mechanisms for reef conservation, due to the extractive nature of the fish collection in the developing countries has severe impacts upon the ecosystem. Even though this effects on the marine fish trading, the trade ultimately disadvantages the environment and the communities where fish collection occurs. Altogether the trader's approach towards the environmental concerns is the primary measure of this variable.

3.5.4.11 Supplier Relationship

In supply chain management strategies maintaining supplier relationship plays an important role (Wisher 2003, Ferry et al. 2015)). Long-term relationships refer to the intention that the arrangement is not going to be temporary (Chen and Paulraj 2004). A successful strategic alliance and integrated relationship with suppliers and buyers are very

much needed for the improvement in performance of the supply chain as a whole. It should be revolved around trust, loyalty, positive-sum game (a win-win relationship), cross-functional teams, achieving common goals and collaboration (Chandra and Kumar 2000). The success of a firm is linked to the strength of its relationship with supply chain partners, and it could reduce and increase revenue. (Spekman, kamauff and Myhr 1998).In supply chain management strategies maintaining supplier relationship plays an important role (Wisher 2003, Ferry et al. 2015)). Long-term relationships refer to the intention that the arrangement is not going to be temporary (Chen and Paulraj 2004).

3.5.4.12 Measure of Customer Satisfaction

Customer satisfaction is an overall satisfaction based on the total quality of the product purchased, and the experience of consumption and service over the time (Fornell 1992). So it is a very significant determinant for the future sales of the product as it positively or negatively affecting the sales of the product (Bearden and Teel 1983). If their experience is positive, the consumer becomes a loyal customer of the product, and by positive word of mouth and continuous purchase, this may affect the future sales of the product. Customer satisfaction is viewed as a post-choice evaluative judgment of a specific purchase occasion (Hunt 1977, Oliver 1977).

3.5.4.13 Degree of Customer satisfaction

Customer satisfaction is essential to every business. Customers have a perception of the performance of the product and expected features such as quality, value, performance and unique features. It is the responsibility of business firms to keep the customer satisfied at all times. This variable measures the level of the satisfaction of the customers.

3.5.4.14 Marketing

Financial success often depends on marketing ability. Good marketing is no accident, but a result of careful planning and execution. Marketing practices are continually being refined and reformed in virtually all industries to increase the chances of success. American marketing association defines “ Marketing as an organizational function and a set

of process for creating, communicating and delivering value to customers and for managing customer relationship in ways that benefit the organization and its stakeholders." Marketing aims to understand the customer so well that the product or service fits him and sells itself (Drucker 1973).

Organizations has to devise marketing activities and programmes to create, communicate and deliver value to consumers. Marketing activities come in all forms. One traditional depiction of marketing activities is regarding the marketing mix which has been defined as a set of marketing tools the firm uses to pursue its marketing objectives (Borden 1994).

Marketing mix decisions are made for influencing the trade channels as well as the final consumers. The firm can change its prize, sales force size, and advertising expenditure in the short run. In ornamental fish supply chain, marketing variable defines employing any marketing activities to increase the sales or to attract the customers.

3.5.4.15 Competition

Competition includes the potential rival offerings and substitutes that a buyer might consider. An organization needs to gather information on the strengths and weaknesses of each competitor. To compete with value-based rivals, mainstream companies must reconsider the perennial routes to business success: keeping costs in line, finding sources of differentiation, and managing prices effectively. To succeed in value based markets, companies are required to infuse these timeless strategies with greater intensity and focus and execute them flawlessly (Frank et al. 2004). In this variable, we are checking whether supply chain members of ornamental fish supply chain feel any competition from the market.

3.5.4.16 Customer Service

Successful organizations need to have a customer-oriented business culture (Shapiro 1988). Since the introduction of the marketing concept, a customer orientation has been identified as the cornerstone of the theory and practice of marketing management (Joworski and Kohlu 1993). It is a result of the explicit assumption that customer-oriented

firms outperform competitors by anticipating the developing needs of customers and responding with goods and services to which superior value and greater satisfaction are consistently attributed. Customer orientation is the basis for organizational learning that results in superior value addition and higher customer satisfaction (Sinkula, Baker and Noordewier 1997). The level of customer service provided to the customers and the strategies for making the customers more satisfied measured using this variable.

3.6 Questionnaire Development

A Questionnaire-based survey measurement is employed in this research work. The questionnaire survey is a traditional approach to get the respondents opinion on a range of issues related to the research problem. This research was conducted to gain the insight, regarding breadth as well as depth, regarding the supply chain of ornamental fishes with particular reference to Kerala state, its performance measurement, risk analysis, marketing strategies and other features.

3.6.1Pretest and Pilot Study

The questionnaire was designed after reviewing the previous literature and studies about the ornamental fish supply chain, performance measurement, risk management in supply chain, sustainability, and marketing strategies. Executives, academicians, and researchers were interviewed to get a clear picture of what they perceived on active instructional principles and operational intrigues of the supply chain. Pretesting was carried out to ascertain whether respondents could understand the measurement items clearly. Pre-testing was done by conducting an in-depth interview of 10 individuals with experience in the ornamental fish trade. There was no ambiguity found at this stage concerning the measurement items.

A pilot test was conducted among 17 supply chain members of ornamental fish trade (target respondents) which aimed at refining the existing questions for improving clarity. The responses were collected from a face to face interview using the questionnaire. The respondents involved in this pretest were salespersons, supervisors and owners of the shops. They are considered suitable persons because they know more about the daily processes, quality requirements and overview of the ornamental fish business. All the

questionnaire were completely and aptly filled for the data collection. All the constructs attained reliability of more than 0.7. This made all the questions valid for future data collection

3.6.2 Final Questionnaire

The questionnaire developed had five sections. The first section dealt with the organizational profile and personal profile of the respondents. The organizational profile includes the type of the firm, respondents category as a supply chain member (breeder, wholesaler, retailer, etc.) their age, experience, and educational qualification.

The second section of the questionnaire sought the information regarding various types of ornamental fishes in trade, most popular ornamental fishes and ornamental fish verities which provide maximum profit to its traders.

The third section of the questionnaire dealt with the performance measurement of the ornamental fish supply chain to measure the performance for analyzing the indicators of performance. The fourth section had questions to find out the risks associated with the supply chain in the form of a ranked data. The respondents were asked to rank the risks associated with particular categories according to their experience and belief. The last section of the questionnaire was on the marketing strategies, sustainability, and environmental considerations.

The questionnaire was developed by including questions which focus on the objectives of the study. Part of the questionnaire has closed type questions in a five-point Likert-scale style format with possible answers of Not at all, Very rarely, Sometimes, Majority times and Always. The responses and its meanings are summarized in Table 2.

Table 3.2: Five Point Likert scale as Measurement

Value	Meaning Assigned
Not at all	You disagree with the statement or not at all follow the statement
Very rarely	You believe that the statement is not true to some extent or follow the statement very rarely
Sometimes	You do not know about it or cannot say
Majority Times	You believe that statement is true or majority times following the statement
Always	You agree with the statement to a great extent

3.6 Questionnaire Administration

Administration of questionnaire was done to collect relevant data from the sources. The target population was analyzed, and samples were drawn accordingly.

3.6.1 Data Collection Method:

The data collection was done using a structured questionnaire through face to face interaction with the suppliers, retailers, wholesalers and salespersons. It was completed in a span of 8 months from May 2015 to December 2015. All the information in the questionnaire were filled by the direct interview method. Data were collected from respondents of more than 30 small towns of Kerala. The details of the data collection are summarized in Table 3.2.

Table: 3.3 Detail of data collection in the ornamental fish supply chain

Characteristics	Details
Population under study	Supply chain members of ornamental fish supply chain, Kerala
Geographical Area	Kerala, State of India
Data Collection Method	Face to face interview
Sample size	97Nos
Time Frame	May-December 2015
Respondent profile	Salesman, retailer, wholesaler, supplier
Response of supply chain members from the sample	100%

3.6.2 Sampling Respondents

Simple random sampling technique was used to select the respondents as the total number, and correct locations in each category of the supply chain are not available. Respondents were classified as breeders, wholesalers, and retailers.

3.6.3 Sample Size:

The total number of such firms or members of the supply chain is estimated to be around 450 according to the study conducted by Sekaran (2001). The data were collected from 97 members of the supply chain. As the total number of members in this supply chain is near 500, this sample size is around 20% which is the accepted norm for any survey-

based research. A response rate of 20% and above is considered to be desirable for survey findings (Yu and Cooper, 1983). Malhothra and Grover (1988) have also suggested a response rate of 20% for a positive assessment of the surveys.

Sekaran (2000) studied the prospects of marketing the indigenous ornamental fish of Kerala with a sample size of 37. This small sample size is due to the small population size existing in the study of Kerala. Even though an increase in the number of supply chain members of ornamental fish in the following years, the sample size 97 can be considered as adequate.

3.6.4Target Respondents:

For this study, breeders, wholesalers, and retailers of ornamental fish supply chain members were targeted to collect response. It provided the best chance to represent the entire supply chain. Majority of the supply chain members are from the districts Malappuram, Kozhikode, Thrissur, Ernakulam and Kollam of the state of Kerala. The persons who are managing the firm on a day to day basis, are interviewed to get a clear picture as compared to the owners of the firms.

Majority of the responsible persons were the willingness to reveal the data required in the questionnaire. As direct interview method was employed, 97 filled data forms were collected within the stipulated time span. As the data collection is by personal interview method, it is possible to clarify the doubts on the questions in the questionnaire.

3.7 Tools of Analysis

This research study had used the questionnaire developed by the researcher as an instrument to the collected data. The data collected was analyzed using the statistical tool SPSS 17.0. Using SPSS, different tests were conducted depending on the nature of the data. The analysis and tests conducted to answer the research questions and tests are as follows.

3.7.1 Reliability Analysis

Reliability is the degree of consistency between two measures of the same variable (Mehrens and Lehman, 1987). It is a measure of the stability, dependability, trustworthiness, and consistency in measuring the same variable at each time (Worthen et al., 1993). Joppe (2000) defines reliability as “the extent to which results are consistent over time, and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable." The reliability analysis of a measuring instrument determines its ability to yield consistent measurement (Flynn et al. 1994). So in any experiment, test or measuring procedure reliability is related to the extent to which the same results can be produced by the repeated trials (Carmines and Zeller, 1979).

The Cronbach alpha coefficient was used as a measure to estimate the internal consistency and reliability. Cronbach’s alpha tells how closely related a set of items are as a group and examine the internal consistency. This method indicates the extent to which items (elements) within a scale are homogenous or correlated (Saraph et al., 1989; Badri et al., 1995). It helps to determine whether the same set of items would elicit the same responses if the same questions are recast to the same respondents. Variables derived from test instruments are declared to be reliable only when they give reliable responses.

Cronbach’s alpha is not a statistical test instead it is a coefficient of reliability. Checking the questions scale is also essential in order to analyze the type of questions and its dimensionality. A "high" value for alpha does not imply that the measure is uni-dimensional. Exploratory factor analysis is one method of checking dimensionality. The theoretical value of alpha varies from zero to 1 since it is the ratio of two variances. According to the procedure and types of analysis, the alpha can take any value less than or equal to 1, including negative values, although only positive values make sense. Higher values of alpha are more desirable.

Table 3.4: Cronbach's alpha value and internal consistency

Cronbach's alpha	Internal Consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor

0.5 > α	Unacceptable

A generally agreed lower limit of the Cronbach's alpha coefficient is 0.7 (Nunnally 1978). Generally, alpha values higher than 0.7 are regarded as sufficient (Nunnally, 1994; Cuieford, 1965), although a cut off value of 0.6 was used by researchers such as Black and Porter (1996), Rungasamy et al., (2002) and Antony et al., (2002). Table 3.3 gives the Cronbach's alpha value and internal consistency.

3.7.2 Content Validity

Content validity refers to the extent to which the variables represents the entire body of content to be measured. An instrument has content validity if it has measurement items that adequately cover the content domains or aspect of the concept being measured (Ahire et al., 1996). The content validity measurement cannot be assumed numerically, but can only be subjectively judged by the researchers (Saraph et al., 1989; Gotzamani and Tsiotras, 2001). The instrument used in this study has been framed after careful and extensive review of the relevant literature. The questionnaire is validated in consultation with the experts. Some of the questions which were not fit according to the specialist in the field of supply chain management were rephrased to make it valid.

3.7.3Construct Validity

Construct validity is carried out to ensure that the variable measures what it is intended to measure (i.e., the construct). Field visits are carried out to different members of the supply chain before commencing the data collection. The normal working of the supply chain members was studied for a better understanding of the possible data sources. It was essential to test the construct validity because the present study was one of its kinds reported in the ornamental fish supply chain.

3.7.4Descriptive Statistics

The descriptive statistics used to describe the data set are the measure of central tendency and variability or dispersion. It also includes a set of brief descriptive coefficients that summarizes a given data set, which can either be a representation of the entire

population or sample. Measures of central tendency include the mean, median and mode, while measures of variability include the standard deviation (or variance), the minimum and maximum variables. Descriptive statistics provide a useful summary of possible returns when performing the empirical and analytical analysis.

3.7.5 Analysis of Variance (One way ANOVA)

One way analysis of variance (ANOVA) is used to determine whether there are any statistically significant differences between the means of two or more independent groups. Here the dependent variable is measured at the continuous level. Independent variables consists of two or more categorical independent groups. Typically a one way ANOVA is used when we have three or more categorical independent groups are present. For two categorical groups independent sample t-test is used.

An independent variable, sometimes called an experimental or predictor variable is a variable that is being manipulated in an experiment in order to observe the effect on a dependent variable, sometimes called an outcome variable. The dependent variable is merely a variable that is dependent on an independent variable. The groups of the independents are also referred to as categories or levels, but the term level is usually reserved for groups that have an order.

3.7.6 Exploratory data analysis

Exploratory data analysis is a convenient method of simultaneously pointing out the group of the variable, which constitutes an independent response set based on their variability (Richard L. Gorsuch 1997). In the present study principle component factor analysis (Varimax rotated) is applied to the sustainability factors.

3.7.7 Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) is used for identification of the sustainability factors that explain the pattern of correlation within a set of observed variables. The purpose of confirmatory factor analysis (CFA) is for labeling those items not loaded in any one of the dimension. According to Clement and Israel, (2005) CFA allow a researcher to

determine the number of factors and loading of the measured variable on them conform to what expected by a pre-established theory. By prior theory, indicator variables are selected, and factor analysis is used to see if they load as predicted on the expected number of factors. The main advantage of CFA over the exploratory factor analysis is that CFA considers and eliminates the measurement errors in relating a variable to the dimension to that extent results are reliable. Further, the number of variables attached to construct could be reduced by the researcher through the confirmatory factor analysis.

3.7.8 Tukey Post Hoc Test

If there exists no prior hypothesis about which specific groups might differ, and the interest is in all possible pairwise comparisons, we can run a post hoc test can be done to test all possible groups of comparisons. The Tukey post hoc test is a good (Westfall et al. 2011) and recommended (Kirk 2013) test for this purpose. The test is useful as it not only provides the statistical significance level (i.e., P-Value) for each pairwise comparison but also provides confidence intervals for the mean difference for each comparison.

3.7.9 Friedman's Ranked Data Test

The Friedman test is a nonparametric statistical test developed by Milton Friedman. Similar to the parametric repeated measures ANOVA, it is used to detect differences in treatments across multiple test attempts and is used to determine whether there are any statistically significant differences between the distributions of three or more related groups. The Friedman test is an extension of the sign test for more than two groups. This test is mostly used if the assumption of normality is markedly violated or dependent variable is measured on the ordinal scale.

3.7.10 Chi-square test for independence

The Chi-Square test of independence determines whether there exists an association between two nominal variables. It does this by comparing the observed frequencies to the expected frequencies if there was no association between the two nominal variables. As the expected frequencies are predicted on the condition that there

being no association, more significant the association between two nominal variables, higher is the chance for the observed frequencies to differ from the expected frequencies.

If the significance value is sufficiently small (usually $p<0.05$), it can be concluded that there is strong enough evidence against the null hypothesis of independence and that there is an association between the two variables in the populations.

3.8 CONCLUSION

This chapter provides a detailed description of the conceptual frameworks for performance measurement, risk assessment, marketing strategies and sustainability studies in the ornamental fish supply chain. Details about the meanings of each variable are explained. The process for the development of the questionnaire and its administration are also explained. A brief description of the different types of tests and its implications are also presented in this chapter.

CHAPTER 4

ORNAMENTAL FISH TRADE - KERALA SCENARIO

4.1 INTRODUCTION

Data collected in the first section of the survey instrument on the ornamental fish supply chain of Kerala are summarized in the succeeding sections. General information on ornamental fish supply chain and the elements of the supply chain in Kerala state are described. The information deducted on significant varieties of ornamental fishes in aquarium business service in Kerala, fishes in trade, most popular fishes, ornamental fishes which provides maximum profit share to the traders are also described. Information on the profiles of existing traders, their educational qualification, experience, age and the sources of income are also presented.

A pilot study was conducted before the questionnaire survey. The comments about the questionnaire during the pilot study were positive which validated that the questionnaire was suitable for the survey. Reliability test for the questionnaire was carried out using Cronbach's Alpha to ensure its consistency. Cronbach's alpha obtained is higher than the threshold value of 0.6, which makes, it is reliable. Kaiser Meyer Olkin (KMO) test result shows the sampling adequacy, with a value of 0.764 which is more than 0.5, the threshold value (Kim, J., & Muller, L.W 1978).

4.2 ORNAMENTAL FISH SUPPLY CHAIN

The information gathered on the category, religion, educational qualification, age groups, experience, significant varieties of ornamental fish marketed, and the major categories of income for the supply chain members are described in this section.

4.2.1 Supply Chain Members Category

Members were allowed to identify themselves on different elements of the supply chain. Since many of them are performing dual roles, opportunity to mark one or more elements related to their trade profile as breeders, wholesalers and retailers were given to

all the supply chain members. The percent of members marked in the breeder category is 17.5 percent, wholesaler category is 28.9 percent, and retailer category is 95.9 percent. Majority of the members are working as the retailers even if they are wholesalers or breeders. The number of supply chain members in each category and the percentage of the members are shown in Table 4.1 and Figure 4.1

Table4.1: Supply Chain Member Category

Category	Frequency	Percent
Breeder	17	17.5
Wholesaler	28	28.9
Retailer	93	95.9

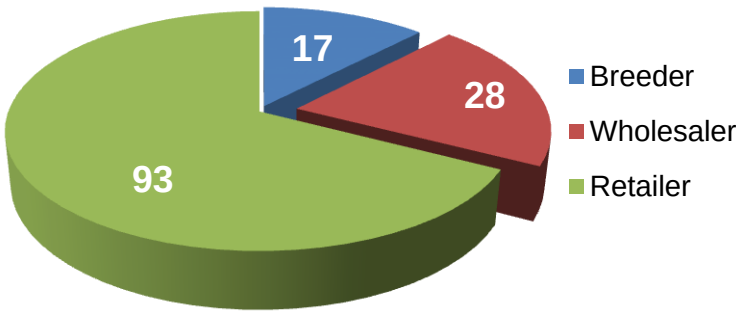


Figure 4.1: Supply Chain Member category

4.2.2 Religion

According to 2011 Census of India figures, 54.73% of Kerala's residents are Hindus, 26.56% are Muslims, 18.38% are Christians, and the remaining 0.32% follows other religion or no religion. As per the statistical data analysis among the members of the supply chain, 40.2% of the populations are coming under Hindus, 52.6% are Muslims and 7.2% are Christians. The numbers of supply chain members in different religions are shown in Table 4.2 and Figure 4.2. Majority of the people engaged in the ornamental fish supply chain belongs to the Muslim religion. It is in accordance with the business of fish and meat in Kerala, as the major percentage of people belongs to the Muslims religion. The

geographical area selected for conducting the survey may be also have influenced on this result.

Table 4.2: Religion of the Supply Chain Members

Religion	Frequency	Percent	Cumulative Percent
Hindu	39	40.2	40.2
Muslim	51	52.6	92.8
Christian	7	7.2	100
Total	97	100	

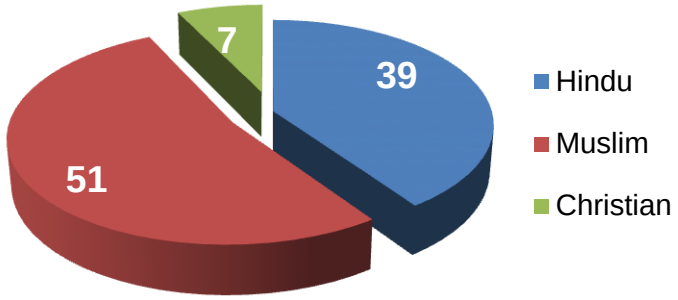


Figure 4.2: Religion of Supply Chain Members

4.2.3 Educational Qualification

Literacy and level of education are the primary indicators of development achieved by a society. Level of education forms an essential input in the overall development of individuals enabling them to comprehend their social, political and cultural environment better and respond to it appropriately. A higher level of education and literacy lead to greater awareness and also contributes to the improvement of economic and social conditions. It acts as a catalyst for social upliftment, enhancing the return on the investment made in almost every aspect of development effort in the employment of weaker sections of the society. According to Census 2011, Kerala has the highest total literacy rate and female literacy rate whereas Lakshadweep had the highest male literacy rate. The educational scenario in Kerala is far advanced than other states of India.

As shown in Table 4.3 and Figure 4.3 majority of the members are having more than higher secondary education or above is (62.8%) as per the analysis of the data (Table 4.3). 25.8% persons are having graduate education level and 8.2% with post-graduate education.

Table 4.3: Educational Qualification of ornamental fish Traders

Educational category	Frequency	Percent	Cumulative Percent
Primary	2	2.1	2.1
Secondary	34	35.1	37.1
Higher Secondary	28	28.9	66
Graduate	25	25.8	91.8
Post Graduate	8	8.2	100
Total	97	100	

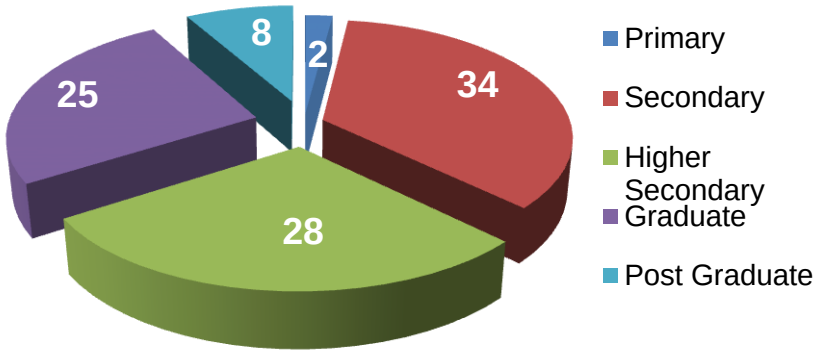


Figure 4.3: Educational Qualification of Ornamental Fish Traders

4.2.4 Age Category

The details of ornamental fish supply chain members under age category are shown in Table 4.4 & Figure 4.4. The percent of supply chain members in the ornamental fish sector having age below 30 years is 12.4% and below 40 is 50.5%. There is an equal share in the age group between below 40 and above 40 in the trade of ornamental fish sector. This results show that, both the age groups have taken up the ornamental fish business for various reasons.

Table 4.4: Age of Ornamental fish traders

Age Category	Frequency	Percent	Cumulative Percent
Below 30	12	12.4	12.4
31 to 40	37	38.1	50.5
Above 40	48	49.5	100
Total	97	100	

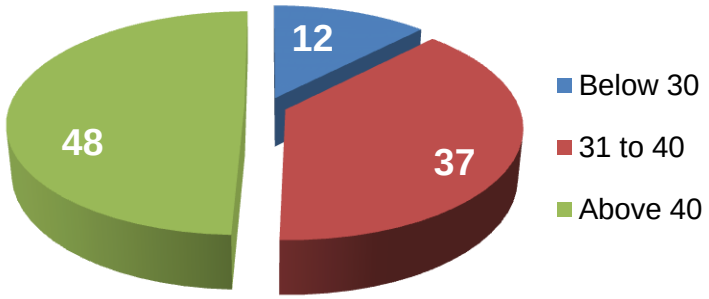


Figure 4.4 : Age of Ornamental Fish Traders

4.2.5 Experience Category:

As shown in Table 4.5 and Figure 4.5 supply chain members are categorized into three groups as per their experience in this field. The first group is with members up to five years of experience, a second group with five to ten years of experience and a third group with traders having more than ten years of experience. 40.2% of the surveyed members are under the category of more than ten years of experience. However, unfortunately, the percentage of traders is decreasing with decreasing experience. It is required to find out the reasons why the new generation youth, are not opting for this business. The need of new promotional schemes and assistance of authorities are required to bring younger generations to this business. Persons with less than five years of experience are only 23.7%.

Table4.5 : Traders category as per their experience

Experience Category	Frequency	Percent	Cumulative percent
Up to 5 Years	23	23.7	23.7
5-10 Years	35	36.1	59.8
More than 10 Years	39	40.2	100
Total	97	100	

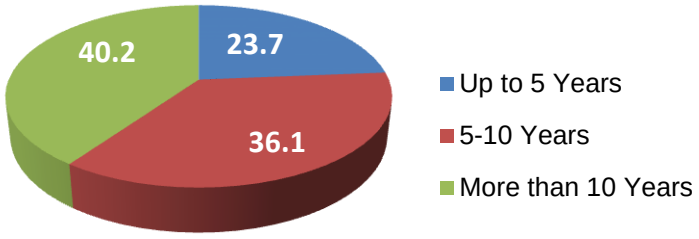


Figure 4.5: Traders category as per their experience

Table 4.6 gives a cross-tabulation of experience and age of the supply chain members. It is found that the peoples in the age groups of 40 and above are taking this significant part as compared to the lower age groups.

Table 4.6: Age and Experience Cross Tabulation

	Experience Category			Total
	Up to 5 Years	5 to 10 Years	More than 10 Years	
Age Category below 30	5	4	3	12
31 to 40	8	18	11	37
Above 40	10	13	25	48
Total	23	35	39	97

4.2.6 Job Category

This analysis is to find out whether the traders in the ornamental fish sector have taken this business as a primary mode of earning income or not. As shown in Table 4.7 and Figure 4.6, 84.5% of the traders have taken up this job as a primary mode of generating income as 15.5% of the traders having other significant sources of income and they treat this business as a leisure time activity or secondary mode of generating income.

Table 4.7: Category of Jobs

Job Category	Frequency	Percent	Cumulative Percent
Primary	82	84.5	84.5
Secondary	15	15.5	100
Total	97	100	

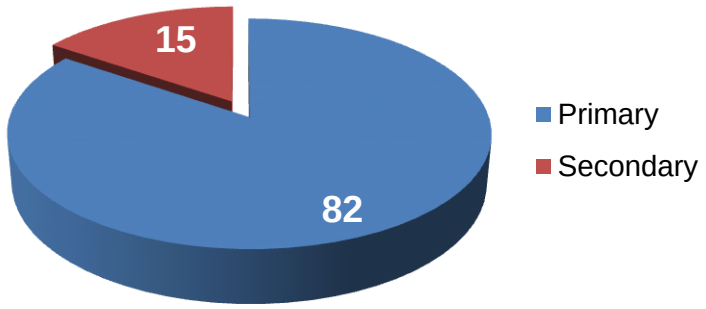


Figure 4.6 : Category of Jobs

4.2.7 Sources of Income

As shown in Table 4.8 majority of the ornamental fish traders are having no other sources of income (60.8%) apart from ornamental fish business. However, 24.7% of the traders are doing pet business along with the trade of ornamental fishes. Various types of dogs, cats and birds are the types of pets in the trade along with the ornamental fish trade. 12.4% of the traders having other sources of income which are not specified.

Table 4.8: Sources of Income

Other Sources of income	Frequency	Percent	Cumulative Percent
No Other Sources of income	59	60.8	60.8
Pet Business	24	24.7	85.6
Other Business	2	2.1	87.6
Yes, But not specified	12	12.4	100
Total	97	100	

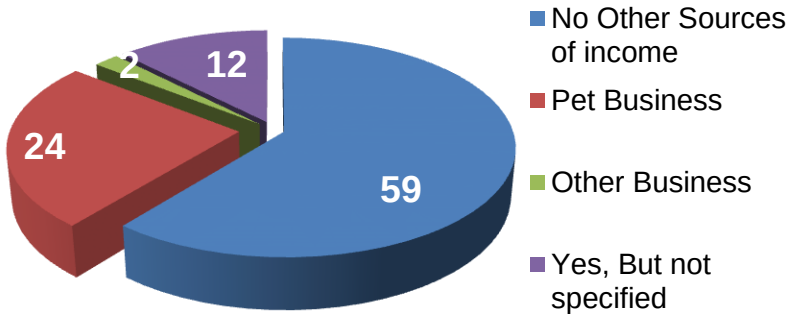


Figure 4.7: Sources of Income

4.2.8 Major Ornamental Fish Varieties

Sekharan (2006) studied the clusters of indigenous ornamental fishes of Kerala which are preferred by customers in the ornamental fish market. The author divided the fish species into highly preferred, medium preferred and low preferred segments. Even though 57 indigenous fishes of Kerala were marketed as ornamental fishes, only a core group accounted for the significant part. In this study, we have not divided the total ornamental fishes into indigenous or not. The objectives were to find out the significant verities of ornamental fishes in trade and favorite ornamental fishes which provide maximum revenue to the suppliers.

Table 4.9: Major Ornamental Fish Varieties in Trade Kerala

Sl No	Major Ornamental fish varieties in Trade	Percentage of Traders
1	Gold fish	97
2	Carp	75
3	Guppy	72.2
4	Cat Fish	71
5	Molly	72
6	Angel	69
7	Gourami	67
8	Oscar	61
9	Paradise fish	61
10	Tetra	58

The results of the analysis are presented in Table 4.9. The dominant fish verities in trade are with family names are Goldfish Carp, Molly, Guppy, Catfish, Angel, Gourami, Oscar, paradise fish and Tetra.

All of the traders have accepted goldfish as the most popular fish in this industry (99%). As per the analysis is shown in the Table 4.10, other principal favorite fishes in the order of acceptance are catfish (57.7%), Molly (37.1%), Oscar (36.1%) and angel (30.9%). As per

the Table 4.11, the major types of fishes which contribute the profit to the traders are goldfish (93.8%), Paradise fish (53.7%), Discus (43%), Carp (33%), and Catfish (27.8%).

Table 4.10: Most Popular Ornamental Fishes

Sl No	Most Popular Ornamental Fishes	Percentage of Traders recommended
1	Gold Fish	99
2	Cat Fish	57.7
3	Molly	37.1
4	Oscar	36.1
5	Angel	30.9

Table 4.11: Ornamental Fishes giving Major profit share

Sl No	Ornamental Fishes giving Major profit shares to the Traders	Percentage of Traders recommended
1	Gold Fish	93.8
2	Paradise Fish	57.7
3	Discus	43
4	Carp	33
5	Cat Fish	27.8

4.3 CONCLUSION

In this chapter, an analysis of the profile of ornamental fish traders, primary fish verities on trade, favorite fishes and fishes giving maximum profit share are presented. From the study, it is revealed that the percentage of a new generation coming into the trade is low as compared to the old generation. This aspect may help the authorities to introduce new policies and to take appropriate decisions to attract the new generation to this trade. Majority of the traders have taken this as their primary mode of job. The educational qualifications of the traders are also reasonably high. These results are also helpful in designing and conducting training programmes for the progress of this business sector.

The analysis on the significant fish varieties according to their contribution to the trade, profit share and popularity will give essential information to the members with less experience and new entrants to the ornamental fish business sector.

CHAPTER 5

PERFORMANCE MEASUREMENT OF ORNAMENTAL FISH SUPPLY CHAIN

5.1 INTRODUCTION

The performance analysis of ornamental fish supply chain, Kerala is presented in this chapter. The performance measurement framework with indicators grouped into four categories namely flexibility, quality, finance & marketing and customer service are used for conducting the survey and analysis.

5.2 METHODOLOGY

Questions on analyzing the performance of ornamental fish supply chain were included in the third section of the questionnaire. The respondents and mode of the interview were the same as that of the first section. It included 26 questions for which a five-point Likert scale was used to measure the responses. 97 supply chain members were selected and face to face interview conducted. The response rate was 100%.

Table 5.1 : Results of Reliability Test

Cronbach's Alpha			Cronbach Alpha
Flexibility	**0.786**	Delivery Flexibility	.725
		Order Flexibility	.755
		Customer Service Flexibility	.852
		Accuracy in Forecasting demand	.710
		Backorders	.856
Quality	0.856	Bench Marking	.816
		Product Quality	.854
		Process Quality	.693
		Service Quality	.742
		Employees Experience	.954
		Records of Testing and Inspection	.842
		Environmental Conditions	.823
Finance and Marketing	0.775	Inventory Cost	.756
		Marketing Cost	.865
		Transportation and Packaging	.795
Customer	0.845	Customer Response Time	.752

Service	Delivery performance	.746
	Customer/ Supplier Relationship	.958
	Degree of Customer Satisfaction	.856

The Cronbach's alpha values of the categories and variables are shown in Table 5.1. It is evident that the questionnaire was reliable with all Cronbach's alpha values greater than 0.6, the threshold value. In this study, all the Cronbach's alpha were more than 0.7 which indicated a high level of internal consistency for the measuring scale. Cronbach's alpha with values 0.7 or higher are recommendable for a questionnaire based research (Devillis 2003, Kline 2005).

5.3 DESCRIPTIVE ANALYSIS

The descriptive analysis of the data is presented in Table 5.2. The responses on the indicators of performance are summarized in this section.

Among the indicators of flexibility, Delivery flexibility is having a highest mean value of 3.7216. It is followed by order flexibility and customer service flexibility with mean values of 3.5464 and 3.4124 respectively. The supply chain members perceive these three as the most important factors of flexibility. Accuracy in the forecast is not considered as an essential indicator of flexibility. The low mean value of 2.5670 is an indication for the same. The standard deviation of the indicator accuracy in forecasting demands is 0.999 which is high as compared to the other indicators.

Among the indicators of quality, respondents have rated the process quality and product quality as the critical factors aiding to quality performance with mean responses of 4.1409 and 4.0619 respectively. Environmental conditions, service quality and experience, are also having mean values higher than 3. The indicator benchmarking has a low mean value of 2.134. It was an indication to the situation that a vast the majority of the supply chain members were not aware of the green certification programme of MPEDA. The low value of 2.8041 for the records of test and inspections indicates that the members are very reluctant to keep the records of test and inspections.

All the four indicators in the Customer satisfaction have mean values more than 3.5. A very high mean value of 4.1186 for the customer/supplier relationship is an indication for a long lasting relationship between the supplier and the customers.

The respondents have rated all the three performance indicators in the Finance and Marketing areas with an average above 3. Among the three indicators, marketing strategies as a method to improve performance are having low mean value. It is evident that employing marketing strategies to enhance the business is not common among members.

TABLE 5.2: Descriptive Statistics of the Responses on Performance Measurement

Indicator	Mean	Std. Deviation
Flexibility		
Delivery Flexibility	3.7216	.55419
Order Flexibility	3.5464	.61272
Customer service Flexibility	3.4124	.61665
Accuracy in Forecasting Demands	2.5670	.99903
Back Orders	3.1753	.73613
Quality		
Bench Marking	2.1340	1.17818
Product Quality	4.1409	.40206
Process Quality	4.0619	.60921
Service Quality	3.5773	.64283
Employees Experience	3.0155	.81475
Records of Testing and inspection	2.8041	1.08627
Environmental conditions	3.6289	.71180
Customer Service		
Customer response time	3.7938	.61132
Delivery performance	3.8454	.52718
Customer/Supplier relationship	4.1186	.41941
Degree of customer satisfaction	3.7268	.43911
Finance and Marketing		
Inventory cost	3.6598	.49763
Marketing	3.2887	.84111
Transportation and Packaging	3.7423	.54540

5.4 PERFORMANCE ANALYSIS OF THE SUPPLY CHAIN

Analysis of performance on different categories of indicators was analyzed by conducting one way ANOVA tests. For this purpose, the respondents are categorized into different groups according to their age, experience and educational qualification.

ANOVA was conducted to test the existence of a significant difference between various groups. The p-value determines whether the mean difference is statistically significant. If the value of p is less than 0.05, the results are statistically significant. However if p is greater than 0.05, the results are statistically not significant. The value “0.000” indicates that p is less than 0.0005 and not that the significance level is equal to zero. However the p-value does not indicate the strength or importance of the mean difference between the two groups. In order to compare between the pairs of groups within each category, Tukey post hoc test was carried out. It was to identify the existence of a statistically significant difference between each pair of the groups.

5.4.1 Flexibility Performance

The analysis of flexibility performance of the supply chain members falling in different groups according to their educational qualifications, age and experience is described in this section. Members of the supply chain are classified into five groups according to the educational level of the supply chain members as having a primary, secondary, higher secondary, graduate and postgraduate education. The mean and standard deviations of these groups are presented in Table 5.3.

The mean value of flexibility performance has increased from 3.1667±0.2357 for the group having the primary education to 3.1814±0.47384 for the group having secondary education and to 3.3512±0.56171 for having a higher secondary education. The mean value of the group having a graduate education is 3.2333±0.44876 and that of postgraduate education is 3.9375±0.51128. As evident from Table 5.3, the flexibility was statistically significantly different for different levels of educational qualifications, with F(4,92)=4.008 and P=0.005. Results of Tukey post hoc analysis given in the Table 5.4 revealed that there exists a significant difference in the flexibility performance between the group of secondary and postgraduate education with p-value = 0.002, higher secondary and postgraduate education with p value=0.034, and graduate and postgraduate groups with p-value =0.006. However, no other differences in performances between groups were statistically significant.

Members of the supply chain are classified according to the age of respondents into three groups, with age below 30, age between 31 and 40, and age above 40. The number

of respondents in these categories was 12, 37 and 48 respectively. Mean values of responses on flexibility performance were different for these three groups. The higher flexibility is observed for the group having age below 30 with mean = 3.6667±0.45505. The flexibility was statistically significantly different for different levels of age groups with F (2, 94) = 3.526 and P=0.033. From Tukey post hoc test results shown in Table 5.4, it is seen that there exists a significant difference in the flexibility performance between groups with age below 30 and age 41 and above with P=0.026. Differences of the mean value of performances of other pairs of groups were not statistically significant.

TABLE 5.3 : ANOVA table of flexibility

Category	Levels	N	Mean	Std. Deviation	F	P
Educational Qualification	Primary	2	3.1667	0.2357	4.008	0.005*
	Secondary	34	3.1814	0.47384		
	Higher Secondary	28	3.3512	0.56171		
	Graduate	25	3.2333	0.44876		
	Post Graduate	8	3.9375	0.51128		
Age	Below 30 years	12	3.6667	0.45505	3.526	0.033*
	30 to 40 years	37	3.2883	0.52945		
	Above 40 Years	48	3.2292	0.51298		
Experience	0-5 Years	23	3.2246	0.5632	1.898	0.156
	5-10 Years	35	3.219	0.47274		
	Above 10 Years	39	3.4316	0.53764		

**The mean difference is significant at the 0.05 level.*

Results of one way ANOVA conducted to identify whether the flexibility was different for different groups based on experience is shown in Table 5.3. The supply chain members were grouped into the three levels as per their experience in their chosen field, having less than five years of experience, five years to ten years of experience and more than ten years of experience. Numbers of respondents in each group were 23, 35 and 39 respectively.

As per the Table 5.3 the flexibility was statistically significantly indifferent to different levels of experience with F (2, 94) = 1.898 and P=0.156. Mean difference in flexibility is highest for the group having above ten years of experience. Due to this reason, Tukey post hoc test was conducted.

TABLE 5.4: Tukey Post Hoc Test-Multiple Comparison of Flexibility Performance

Independent Variable	Group I/ Level I	Group J/ Level J	Flexibility	
			Mean Difference (I-J)	P Value
Educational Qualification	Primary	Secondary	-0.01471	1
		Higher Secondary	-0.18452	0.986
		Graduate	-0.06667	1
		Post Graduate	-0.77083	0.291
	Secondary	Higher Secondary	-0.16982	0.666
		Graduate	-0.05196	0.995
		Post Graduate	-0.75613	0.002*
	Higher Secondary	Graduate	0.11786	0.909
		Post Graduate	-0.58631	0.032*
	Graduate	Post Graduate	-0.70417	0.006*
Age	Below 30	31 to 40	0.37838	0.073
		Above 40	0.4375	0.026*
	31 to 40	Above 40	0.05912	0.858

**The mean difference is significant at the 0.05 level.*

5.4.2 Quality Performance

The analysis of the responses on Quality performance as perceived by the supply chain members grouped according to their educational qualifications, age and experience are described in this section. The mean and standard deviations of these groups and the results of the ANOVA test conducted are presented in Table 5.5. Results of the Tukey Post hoc tests conducted for the categories where a significant difference in the mean value of the groups exists is shown in Table 5.6

The mean values of responses of the groups classified according to the education level of supply chain members increase with the increase in the educational level. The quality performance was statistically different for different levels of educational qualification which is indicated by F (4, 92) value of 2.929 and P value of 0.025. Tukey post hoc analysis conducted on pairs of groups revealed that a significant difference exists in the quality performance as perceived by respondents having higher secondary education and graduate level education.

The mean values of quality performance are different for different groups classified according to the age of the respondents. The mean value for the group of age below 30 is

3.5076 ± 0.56102, for age between 30 and 40 is 3.4369 ± 0.37503 and for age above 40 is 3.5114 ± 0.3571. One way ANOVA test conducted on age groups shows no statistically significant difference in quality performance between different groups with F (2, 94) value of 0.396 and p-value 0.674. Tukey post hoc test is not conducted in this grouping as a significant difference in quality performance between groups did not exist.

The quality performance is statistically different for different groups classified according to the experience of the respondents with F (2,94) value of 3.27, with p-value of 0.042. Tukey post hoc analysis brought out a significant difference in quality performance between the groups with experience levels up to 5 years and experience with more than 10 years.

TABLE 5.5: ANOVA Table of Quality Performance

Category	Levels	N	Mean	Std. Deviation	F	P
Educational Qualification	Primary	2	3.2273	0.06428	2.929	0.025*
	Secondary	34	3.3289	0.39596		
	Higher Secondary	28	3.5253	0.46719		
	Graduate	25	3.6073	0.25541		
	Post Graduate	8	3.6705	0.24748		
Age	Below 30 years	12	3.5076	0.56102	0.396	0.674
	30 to 40 years	37	3.4369	0.37503		
	Above 40 Years	48	3.5114	0.35711		
Experience	0-5 Years	23	3.3123	0.37465	3.279	0.042*
	5-10 Years	35	3.5027	0.35825		
	Above 10 Years	39	3.5664	0.40466		

**The mean difference is significant at the 0.05 level.*

TABLE 5.6: Tukey Post Hoc Test-Multiple Comparison of Quality Performance

Independent Variable	Group I/ Level I	Group J/ Level J	Quality	
			Mean Difference (I-J)	P Value
Educational Qualification	Primary	Secondary	-0.1016	0.996
		Higher Secondary	-0.29798	0.815
		Graduate	-0.38	0.644
		Post Graduate	-0.44318	0.57
	Secondary	Higher Secondary	-0.19638	0.261
		Graduate	-0.2784	0.046*
		Post Graduate	-0.34158	0.15
	Higher Secondary	Graduate	-0.08202	0.934
		Post Graduate	-0.1452	0.872
	Graduate	Post Graduate	-0.06318	0.994

Experience	0-5 Years	5-10 Years	-0.19042	0.16
		Above 10 Years	-0.25418	0.034*
	5-10 Years	Above 10 Years	-0.06376	0.757

**The mean difference is significant at the 0.05 level.*

5.4.3 Performance in Customer Service

The results of the mean values of the customer service score with different levels of educational qualification, experience and age groups are shown in Table 5.7. From one way ANOVA test, performance in customer service was statistically significantly indifferent with different levels of educational qualification, age groups and experience levels as P values of all the categories were above 0.005. It implied that there were no differences in the activities of customer service among between different levels of age, education and experience. Since statistically significant differences did not exist among the classified groups, Tukey Post Hoc test was not conducted for the classifications.

TABLE 5.7: Descriptive and ANOVA table of customer service

Category	Levels	N	Mean	Std. Deviation	F	P Value
Educational Qualification	Primary	2	3.9167	0.58926	1.929	0.112
	Secondary	34	3.9265	0.26965		
	Higher Secondary	28	3.8929	0.31822		
	Graduate	25	3.9133	0.24589		
	Post Graduate	8	3.625	0.26352		
Age	Below 30 years	12	3.9722	0.26432	0.917	0.403
	30 to 40 years	37	3.8468	0.26463		
	Above 40 Years	48	3.8993	0.31273		
Experience	0-5 Years	23	3.9203	0.27001	0.837	0.436
	5-10 Years	35	3.919	0.28114		
	Above 10 Years	39	3.8419	0.30815		

*The mean difference is significant at the 0.05 level.

5.4.4 Performance on Finance and Marketing

Mean and standard deviation of the responses for performance in Finance and marketing for different levels of educational qualification, age and experience are tabulated in Table 5.8. The performances in finance and marketing are statistically significantly different for different age groups with F(2,94) value of 5.271 and the p-value 0.007, for

different levels of education with F(4,92) value of 6.315 and p-value 0.000 and for different levels of experience with F(2,94) value of 5.092,and p-value 0.008.

In different levels of experience groups shown in Table 5.9, the Tukey post hoc analysis revealed that there existed a statistically significant difference between group having less than five years of experience and having five to ten years of experience with P value 0.006. The group with age below 30 is statistically significantly different with a group having age between 30 and 40 with p-value equal to 0.005 and also with the group having age above 40 with p-value is equal to 0.022.

TABLE 5.8 : Descriptive and ANOVA table of finance and marketing

Category	Levels	N	Mean	Std.Deviation	F	P Value
Educational Qualification	Primary	2	3.3333	0.4714	6.315	0.00*
	Secondary	34	3.5	0.41235		
	Higher Secondary	28	3.3571	0.44378		
	Graduate	25	3.8533	0.23727		
	Post Graduate	8	3.7083	0.37533		
Age	Below 30 years	12	3.2222	0.60858	5.271	0.007*
	30 to 40 years	37	3.6577	0.36419		
	Above 40 Years	48	3.5764	0.37498		
Experience	0-5 Years	23	3.3478	0.5073	5.092	0.008*
	5-10 Years	35	3.6952	0.34652		
	Above 10 Years	39	3.5726	0.38955		

**The mean difference is significant at the 0.05 level.*

TABLE 5.9: Tukey post hoc test- Multiple comparison chart with finance and marketing

Category	Group I (Level I)	Group J/ (Level J)	Finance and Marketing	
			Mean Difference (I-J)	P Value
Age	Below 30	31 to 40	-0.43544	0.005*
		Above 40	-0.35417	0.022*
	31 to 40	Above 40	0.08127	0.632
Experience	0-5 Years	5-10 Years	-0.34741	0.006*
		Above 10 Years	-0.22482	0.094*
	5-10 Years	Above 10 Years	0.12259	0.401
Educational Qualification	Primary	Secondary	-0.16667	0.975
		Higher Secondary	-0.02381	1
		Graduate	-0.52	0.353

		Post Graduate	-0.375	0.729
	Secondary	Higher Secondary	0.14286	0.59
		Graduate	-0.35333	0.006*
		Post Graduate	-0.20833	0.639
	Higher Secondary	Graduate	-0.49619	0*
		Post Graduate	-0.35119	0.158
	Graduate	Post Graduate	0.145	0.884

**The mean difference is significant at the 0.05 level.*

The group having a secondary education is statistically significantly different from graduate level with a 'p' value of 0.006, and group with higher secondary education is significantly different with a group having a graduate education with a P value less than 0.0005. Responses of age below 30 are statistically different from both the other age groups. The responses of the members of the group having experience up to 5 years are also significantly different from all other levels of experience.

5.5 CONCLUSION

A Measurement system is designed and applied for measuring the performance of all members of the ornamental fish supply chain. The study also focused on the significance of this performance components in different groups based on the age, educational qualification and experience. Results of the study brought out the existence of statistical significances in various performance indicators with different age groups, educational qualification and experience. The result also revealed that the members of the supply chain are not aware of the green certification programme of MPEDA to maintain the quality of the ornamental fishes. It is the first study after the implementation of this certification programme in the year 2008.

CHAPTER 6

SUPPLY CHAIN RISK ASSESSMENT IN THE ORNAMENTAL FISH SUPPLY CHAIN

6.1 INTRODUCTION:

The systematic risk management plays a crucial role in confronting the emerging challenges of the business. This chapter presents the data analysis and the results of the questionnaire-based survey on the risks and its categories associated with the ornamental fish supply chain. The risks are grouped into six categories namely macro-level risks, demand-side risk, supply risk, quality risk, risk on asset and infrastructure and financial risk by prolonged study and deliberation with field experts. The data collected from the supply chain members were analyzed with the application of statistical software tool SPSS 17.0.

6.2 METHODOLOGY

Data were collected by asking respondents to rank the risks according to their perception. The response level is 100% from 97 supply chain members of ornamental fish supply chain Kerala. The Friedman's ranked data test was conducted to find out the significant difference between risks in various risk categories as the data is ordinal where normality cannot be assumed. The test is a non-parametric alternative to the one way ANOVA test. Chi-square test (Agresti, A. 2013) has been used to test the association between two nominal variables.

6.3 FINDINGS OF THE STUDY

The findings of the study conducted on different risk categories in the ornamental fish supply chain are discussed in succeeding sections.

6.3.1 Macro Level Risk

The different risks in the macro level risk category, their mean ranking with percentile scores and the ranking are given in Table 6.1. The result of the Chi-square test conducted on macro-level risk categories is shown in the Table 6.2 reveal that there is a significant

difference among the risks with χ^2 (5) of 361.6 and p-value of 0.00. The median score was minimum for the risks due to diseases/health hazards, natural disaster and labor risk for which median scores are 1, 2 and 3 respectively. These are the major sources of risk among the macro level risk category. The risk due to terrorist attacks was having the highest Median score of six. Changing government regulation and the political unrest were ranked 4 and 5 respectively. These three risks are not perceived as significant risks affecting the supply chain.

Table 6.1: Descriptive Statistics of Macro level Risks

Risks	N	Percentiles			Mean Rank	Rank
		25th	50th (Median)	75th		
Natural disaster	97	2.0000	3.0000	3.0000	2.77	2
Diseases/Health Hazards	97	1.0000	1.0000	1.0000	1.26	1
Political Unrest	97	4.0000	5.0000	5.0000	4.42	5
Terrorist attacks	97	6.0000	6.0000	6.0000	5.95	6
Government regulations	97	3.0000	4.0000	5.0000	3.82	4
Labor risk	97	2.0000	3.0000	3.5000	2.78	3

Table 6.2: Friedman Test Statistics Macro level Risk

N	97
Chi-Square	361.604
df	5
Asymp. Sig.	.000

6.3.2 Demand Risk

Risks included in the demand risk category, median, percentiles, and rank of the risks as obtained from Friedman's test are shown in Table 6.3. The significant risks in this category are sudden loss of demand for which median is equal to 1 and error in forecasting for which median is equal to 3. The minor risk in this category is communication failure with customers with the median value of 5. Other risks namely Volatile demand, Change in customer taste and Inability to meet demand are also having low median ranks. Demand risk category is statistically significantly different with the analysis result of χ^2 (5) value of 135 and P value of 0.00 as shown in Table 6.4.

Table 6.3: Descriptive Statistics of Demand Risk

Risks	***N***	***Percentiles***			***Mean Rank***	***Rank***
		25th	***50th (Median)***	***75th***		
Sudden loss of demand	97	1.0000	1.0000	2.0000	1.70	1
Volatile demand	97	3.0000	4.0000	5.0000	3.73	4
Change in customer taste	97	2.0000	4.0000	5.0000	3.65	3
Communication failure with customers	97	4.0000	5.0000	6.0000	4.53	6
Inability to meet demand	97	3.0000	4.0000	6.0000	4.16	5
Error in forecasting	97	2.0000	3.0000	4.0000	3.23	2

Table 6.4: Chi-Square Test Statistics of Demand Risk

N	97
Chi-Square χ^2	135.077
df	5
Asymp. Sig.	.000

6.3.3 Supply Risk

The significant supply risks identified with the ornamental fish supply chain as shown in Table 6.6 are communication failure and absence of competent supplier with median values two. Both partnership failure and absence of supplier strategy having median values of four were the minor risks. The result of the Friedman' test on supply risk category shown in Table 6.6 revealed that there exist significant differences in the variables of the risks classified under the category with $\chi^2 = 103.14$ and P = 0.00.

Table 6.5: Descriptive Statistics of Supply Risk

Risks	N	Percentiles			Mean Rank	Rank
		25th	50th (Median)	75th		
Communication failure	97	1.0000	2.0000	3.0000	2.05	1
Partnership failure	97	3.0000	4.0000	4.0000	3.69	4
Absence of supplier strategy	97	3.5000	4.0000	5.0000	3.89	5
Absence of competent suppliers	97	1.0000	2.0000	3.0000	2.30	2
Absence of suppliers with common objectives	97	2.0000	3.0000	5.0000	3.07	3

Table 6.6: Chi-Square Test Statistics of Supply Risk

N	97
Chi-Square	103.184
df	4
Asymp. Sig.	.000

6.3.4 Quality Risk

Results of the Friedman's test given in the Table 6.8 revealed that the maintenance of quality with median one and lack of suppliers with quality rating median two as the significant risks in the category. Maintenance of proper documents and facilities for keeping good quality products are the minor risks in this category with median 5 and 6 respectively. TheTest Statistics given in Table 6.9 shows the existence of a significant difference in the risks indicates classified under this category with $\chi^2(5)$ value 196.046 and p-value of 0.00.

Table 6.7: Descriptive Statistics of Quality Risk

Risks	***N***	***Percentiles***			***Mean Rank***	***Rank***
		25th	***50th (Median)***	***75th***		
Testing for suppliers quality rating	97	1.0000	2.0000	2.0000	2.14	2
Maintenance of quality	97	1.0000	1.0000	3.0000	2.06	1
Maintenance of proper documents	97	4.0000	5.0000	5.0000	4.55	5
Lack of skilled persons	97	2.0000	4.0000	5.0000	3.60	3
Facilities for keeping good quality products	97	4.0000	6.0000	6.0000	4.92	6
Facilities to give proper training for employees	97	3.0000	3.0000	5.0000	3.73	4

Table 6.8: Test Statistics of Quality Risk

N	97
Chi-Square	196.046
df	5
Asymp. Sig.	.000

6.3.5 Asset and Infrastructure

The test results of risks in assets and infrastructure as shown in Table 6.9 and Table 6.10. Excessive inventory and inward logistics were the significant risks associated with

asset and infrastructure with medians of one and three respectively. The minor risk was the usage of hazardous materials with a median of 6. The values of $\chi^2(5)$ of 251.7 and p of 0.00, confirms that there exists a significant difference between various risks in this category.

Table 6.9: Descriptive Statistics of Asset and Infrastructure risk

Risks	N	Percentiles			Mean Rank	Rank
		25th	50th (Median)	75th		
Excessive inventory	97	1.0000	1.0000	1.0000	1.52	1
Underutilized capacity	97	3.0000	4.0000	5.0000	3.72	4
Inward logistics	97	2.0000	3.0000	4.0000	2.94	2
outward logistics	97	3.0000	4.0000	5.0000	3.86	5
usage of hazardous materials	97	6.0000	6.0000	6.0000	5.65	6
nonavailability of proper packaging materials	97	2.0000	4.0000	4.0000	3.32	3

Table 6.10: Chi-Square Test Statistic of Asset and Infrastructure risk

N	97
Chi-Square	251.716
df	5
Asymp. Sig.	.000

6.3.6 Financial Risk

The results of Friedman's test on financial risk is shown in Table 6.11. The major financial risks were the profit with the median value of one and investment with the median value of two. Both ownership and government regulations with median values of five were the minor risks. The results of the Chi-square test shown in the Table 6.12 revealed that there was no significant difference in the risks with $\chi^2(5)$ of 249.43 and p of 0.00.

Table 6.11: Descriptive Statistics of Financial Risk

Risks	***N***	***Percentiles***			***Mean Rank***	***Rank***
		25th	***50th (Median)***	***75th***		
investment	97	1.0000	2.0000	4.0000	2.74	2
profit	97	1.0000	1.0000	2.0000	1.66	1
return on investment	97	2.0000	3.0000	3.0000	2.90	3
ownership	97	4.0000	5.0000	6.0000	5.08	6
government funding	97	4.0000	5.0000	6.0000	4.97	5
lack of proper training	97	3.0000	4.0000	5.0000	3.65	4

Table 6.12: Chi-Square Test Statistic of Financial Risk

N	97
Chi-Square	249.343
df	5
Asymp. Sig.	.000

6.4 CONCLUSION

Perceptions of risks specific to ornamental fish supply chain were evaluated using a conceptual framework. The risks associated with ornamental fish supply chain were classified into six heads namely macro-level risks, demand risk, supply risks, quality risks, risks on asset and infrastructure, financial risks. Data on the different types of risks and their rankings were collected from among the supply chain members using a questionnaire.

The significant risks involved in the macro level category are diseases/health hazards, natural disaster, and labor risk. Demand category confronts the sudden loss of demand and error in forecasting. Supply risk category comprises of communication failure and absence of suppliers with common objectives as the significant risks. Maintenance of quality and lack of suppliers with rating are the significant hurdles that come under the quality category. Inventory, logistic problems, profit, and investment are the other relevant risks in the ornamental fish supply chain.

Majority of the supply chain members did not receive any government aids for the development of their business. However, the majority of supply chain members did not consider it as a risk factor, as they were not expecting any governmental aids. Volatile

demand, change in customer taste and maintenance of proper documents were the moderate risks. Most of the members are having excellent facilities for keeping good quality products. Terrorist attacks, political unrest, partnership failure, usage of hazardous materials and ownership are classified as the minor risks associated with the supply chain.

The risk measurement framework developed for the study allows supply chain members to extend a clear view on risks related to the entire fish supply chain. It is also useful for the members to get acquainted with different strategies to cop up with the risks. The framework can also be applied to check the changes in perceptions of risks concerning the demographic variables. Even though the framework developed mainly for the analysis of risks in the ornamental fish supply chain, it can be used for the analysis of similar supply chains with necessary modifications.

CHAPTER 7

MARKETING STRATEGIES AND GREEN CERTIFICATION IN ORNAMENTAL FISH TRADE

7.1 INTRODUCTION

The investigations on the ornamental fish business and its activities in Kerala by analyzing its scope, potential and problems are presented in this chapter. The strategies adopted in the marketing of ornamental fish business and their impacts on the revenue of the firms are also analyzed. Sustainability practices adopted in the business of ornamental fish also studied as a part of this survey.

Questions on the approach of supply chain members towards the environmental implications of the business and Extend of knowledge on the proposed Green Certification Programme of Marine Product Export Development Authority of India (MPEDA), were included in the questionnaire.

7.2 Results and Discussion

The number of varieties of fish offered to the customers is an essential aspect of the ornamental fish business. Details of the number of varieties offered by firms are shown in Table 7.1. More than 50 percentages of the firms were trading 20 or more varieties. Nearly 30 percent of the firms were trading more than 30 varieties.

Table 7.1: Number of fish varieties trading by the firms

Varieties	Frequency	Percent	Cumulative Percent
Less than 10	10	10.3	10.3
10-20	36	37.1	47.4
20-30	22	22.7	70.1
More than 30	29	29.9	100.0
Total	97	100.0	

Weekly turnover of the supply chain members is shown in Table 7.2. Fifty percent of the firms were having a weekly turnover of more than 10000 rupees and 14.4 percent of the firms having more than 25000 rupees.

The revenue from the ornamental fish business is not by selling the ornamental fishes alone, but from selling the accessories, and aquarium preparation, services as well. The contributions to revenue from other sectors were also examined in the study.

Table 7.2: Weekly turnover of the firm

	Frequency	Percentage	Cumulative Percent
Less than 5000	14	14.4	14.4
5000-10000	32	33.0	47.4
10000-25000	37	38.1	85.6
More than 25000	14	14.4	100.0
Total	97	100.0	

The supply chain members were asked to rank the sources of profit in a scale of 1 to 5. Five sources of profit were included in the questionnaire namely ornamental fish trade, packaging materials, aquarium preparation, sales of accessories and services. Table 7.3 shows the sources of profit of the supply chain members. The significant profit share was from the sales of accessories, followed by aquarium preparation and sales of packaging materials. Profit share from service is the least.

Table 7.3: Rank of profit share from ornamental fish trade categories

Ornamental fish trade categories	Frequency of Ranks					Total	Average	Rank
	1	2	3	4	5			
Ornamental Fish Trade	18	13	35	28	3	97	2.845361	4
Packaging Materials	22	24	32	9	10	97	2.597938	3
Aquarium Preparation	23	31	13	23	7	97	2.587629	2
Sales of Accessories	34	28	10	24	1	97	2.278351	1
Services	0	1	7	13	76	97	4.690722	5

The details of promotional schemes and offers are in Table 7.4. No firms were using television advertisement as a means for promotion. The expected return from their business and advertisement rates may not be justifiable. Only two supply chain members were using

newspaper advertisement for promotion. Majority of them are using notices and visiting cards. 35 percentages of the firms using new media like Facebook and WhatsApp for their sales promotion.

Table 7.4: Firms using promotional schemes and promotional offers

Category		Firms using promotional schemes/ offers	Firms not using promotional schemes/ offers	Percentage of firms using promotional schemes/ offers	Total
Promotional Schemes	TV Advertisement	0	97	0	97
	News Paper Advertisement	2	95	2.061856	97
	Advertisement through new media	34	63	35.05155	97
	Notices	70	27	72.16495	97
	Visiting Cards	75	22	77.31959	97
promotional offers	Discount	82	15	84.53608	97
	Door Delivery	82	15	84.53608	97
	Free maintenance	24	73	24.74227	97
	Replacement of death items	2	95	2.061856	97

Around 85 percent of the firms were using the discount as the promotional offer. Almost all the firms are ready to deliver their products at the customer sites. Very few are ready to replace the dead fish.

Table 7.5: Firms following the procedure prescribed by green certification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Note at all	33	34.0	34.0	34.0
	very rarely	41	42.3	42.3	76.3
	sometimes	5	5.2	5.2	81.4
	Majority times	13	13.4	13.4	94.8
	Always	5	5.2	5.2	100.0
	Total	97	100.0	100.0	

This survey is the first of its kind after the implementation of green certification programme in the year 2012, investigating the awareness on green certification and its procedures among the supply chain members of ornamental fish business in the state. However, the results were not satisfactory. As shown in Table 7.5, Majority of the firms or

traders were not aware of the green certification programme. As per the analysis, more than 75 percentage of the firms do not or very rarely use the prescribed procedures in all their activities of ornamental fish trade. Only 19 percent of the firms follow the procedures.

7.3 CONCLUSION

The study has been conducted among ornamental fish traders of Kerala state primarily to determine marketing strategies and schemes adopted. Checking the environmental consideration and approach towards the certification programmes were also a part of the study. A number of varieties of ornamental fishes in trade, sources of revenue and promotional methods adopted are identified through this study.

Proper training is required to be provided on the adoption of scientific procedures for the trade; it would be useful for the development of the ornamental fish business. Even though the majority of the supply chain members is not aware of the certification programmes or procedures developed by the government; the members were more aware of the environmental considerations.

The study also revealed that a significant part of the traders was not using any of the promotional schemes except notices or visiting cards. Now a day's it is possible to use social media for sales promotion activities and advertisement. The educational qualifications of the supply chain member and their awareness toward environmental problems are the decisive factors that can be effectively utilized for the development of the ornamental fish business.

CHAPTER 8

FACTOR ANALYSIS ON SUSTAINABILITY

8.1 INTRODUCTION

Factor analysis of the variables of sustainability factors about the ornamental fish supply chain is carried out in this chapter. The tools used for analysis and the results of the analysis explained in the following sections.

8.2 METHODOLOGY

The variables of the sustainability of supply chains in general and ornamental fish supply chain, in particular, have been identified from the literature. Detailed representation of the 16 variables identified and their interpretations are described in chapter 3. The parts of the questionnaire on variables of sustainability consisted of sixteen questions. A five-point Likert scale ranging from 1 to 5 was used to measure the responses. Face to face interview was conducted with 97 members, with the response rate of 100%. The research details are shown in Table 8.1

Table 8.1: **Research Details**

Characteristics	***Research Data***
Population Under Study	Members of Ornamental Fish Supply Chain
Geographical Area	Kerala, State of India
Data Collection Method	Face to face Interview
Sample size	97
Timeframe	May- December 2015
Respondents profile	Sales persons, wholesalers, retailers, and suppliers
Response rate	100%

Factor analysis was conducted to explain the pattern of correlation between variables. By forced factor extraction method the variables were grouped into three categories namely environmental, economic and social factors. One way analysis of variance (ANOVA) was used to determine whether there existed any statistically significant differences between the means of two or more independent groups. Here one way ANOVA was used to find the significant differences between environmental, social and economic

factors with different groups of educational qualification, age, and experience. Tukey-post hoc test was conducted to determine the existence of significant differences between the groups.

The Tukey post hoc test is a good (Westfall et al. 2011) and recommended (Kirk 2013) test for pair-wise comparisons in all possible ways in which no prior hypothesis about which specific groups of interest might differ. The test is useful; it not only provides the statistical significance level (i.e., p-Value) for each pair-wise comparison but also provides confidence intervals for the mean difference for each comparison. The value of ‘p’ determines whether the mean difference is statistically significant. If the p is less than 0.05 statistically significant result exists and p is higher than 0.05, the result is not statistically significant. If the value is "0.000" means that p is remarkably less than 0.0005; it does not mean that significant level is zero. However, the p-value does not indicate the strength or importance of the mean difference between the two groups.

8.3 FACTOR ANALYSIS

Factor analysis attempts to identify underlying variables, or factors, that explain the pattern of correlation within a set of observed variables. It is often used in data reduction to identify a small number of factors that explain most of the variables observed in a much more significant number of manifest variables. It can also be used to generate a hypothesis regarding casual mechanism available for subsequent analysis.

In the present study, factor analysis was conducted with a total of 16 variables, which was 97÷16 = 6.1 respondents per variable. One can, therefore, conclude that the sample size is fair compared to the number of variables. Kass and Tinsley (1979), recommended having 5 to10 participants per variable for factor analysis.

Important initial tests are Keiser-Mayer Olkin (KMO) measure, Barlett's test of sphericity and checking anti-image correlation and covariance matrices. The KMO measure tests whether the partial correlations among variables are small (Field, 2005). A measure of over 0.5 is barely acceptable. Values between 0.5 and 0.7 are mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are greet, and the values above 0.9 are

superb (Kaiser, 1974). As seen in the analysis presented in Table 8.2, the KMO for all 16 variables was 0.731 which was good enough for further analysis.

Table 8.2: **Factor Analysis: KMO and Bartletts test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.731
Bartlett's Test of Sphericity Approx. Chi-Square	689.433
df	120
Sig.	.000

The KMO for the individual variable can be found by looking at the bolded diagonal elements in the anti-image correlation matrix shown in Table 8.3. All these variables should have a KMO value above 0.5 and preferably higher (Field, 2005). As seen from the table, only one variable was slightly below the threshold. Since no significant changes in the overall KMO measure were observed when this variable was removed, it was decided to keep all the variables.

Table 8.3: Anti-Image Correlation Matrix

Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	**.832**[a]	-.336	-.135	.050	-.206	-.289	-.313	.058	.035	-.032	.008	-.162	.175	.168	-.080	.160
2	-.336	**.759**[a]	-.103	.232	.207	.263	-.408	-.100	-.030	.076	-.339	.153	-.006	-.246	-.137	-.553
3	-.135	-.103	**.418**[a]	-.438	.044	.150	.052	-.201	-.002	.184	.110	.085	-.206	.188	-.172	.100
4	.050	.232	-.438	**.566**[a]	-.157	-.084	-.040	.283	-.109	-.159	-.102	-.029	.214	-.284	.084	-.047
5	-.206	.207	.044	-.157	**.646**[a]	.220	-.255	.202	.033	-.018	-.066	-.052	-.143	.001	-.087	-.027
6	-.289	.263	.150	-.084	.220	**.702**[a]	-.182	-.161	-.239	.219	-.254	.256	.023	-.039	-.157	-.083
7	-.313	-.408	.052	-.040	-.255	-.182	**.846**[a]	.044	-.257	.018	.170	.022	-.163	-.132	-.089	.095
8	.058	-.100	-.201	.283	.202	-.161	.044	**.735**[a]	-.320	-.173	-.340	.119	-.037	-.187	.203	.048
9	.035	-.030	-.002	-.109	.033	-.239	-.257	-.320	**.740**[a]	-.040	.329	-.378	-.155	.055	.170	-.071
10	-.032	.076	.184	-.159	-.018	.219	.018	-.173	-.040	**.597**[a]	.013	.043	.098	.026	-.169	-.033
11	.008	-.339	.110	-.102	-.066	-.254	.170	-.340	.329	.013	**.702**[a]	-.404	-.011	.076	-.122	.055
12	-.162	.153	.085	-.029	-.052	.256	.022	.119	-.378	.043	-.404	**.663**[a]	.085	-.110	-.258	-.230
13	.175	-.006	-.206	.214	-.143	.023	-.163	-.037	-.155	.098	-.011	.085	**.743**[a]	-.309	-.330	.132
14	.168	-.246	.188	-.284	.001	-.039	-.132	-.187	.055	.026	.076	-.110	-.309	**.708**[a]	.228	.029
15	-.080	-.137	-.172	.084	-.087	-.157	-.089	.203	.170	-.169	-.122	-.258	-.330	.228	**.730**[a]	.169
16	.160	-.553	.100	-.047	-.027	-.083	.095	.048	-.071	-.033	.055	-.230	.132	.029	.169	**.743**[a]

[a] *Measures of Sampling Adequacy (MSA)*

The last control before moving on to the principal component analysis was to conduct the Bartletts tests of sphericity and obtain a significance level above 0.05. This test

identifies whether the correlation between variables is sufficiently high for the factor analysis to become appropriate (Field, 2005). It is seen from the Table 8.2 that Bartlett's test is highly significant (P<0.001) and good enough for the analysis. The tests of preliminary analysis concluded that the variables have satisfactory characteristics to proceed to conduct a factor analysis.

8.4 FACTOR EXTRACTION

The principal component analysis of all the 16 variables yielded three factors using forced factor extraction method. The component loading and communalities of the rotated solution presented without suppressed coefficients are illustrated in Table 8.4 and Figure 8.1. The three component solution explained 54% of the total variance. A varimax orthogonal rotation was employed to aid interpretability. The interpretation of the data was consistent with the sustainability attributes.

Table 8.4: **Total Variance Explained**

Component	*Initial Eigen Values*			*Extraction Sums of Squared Loading*			*Rotation Sums of Squared Loading*		
	Total	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*
1	5.100	31.877	31.877	5.100	31.877	31.877	3.074	19.210	19.210
2	2.154	13.460	45.338	2.154	13.46	45.338	2.917	18.234	37.444
3	1.400	8.749	54.087	1.400	8.749	54.087	2.663	16.643	54.087
4	1.205	7.530	61.617						
5	0.959	5.992	67.608						
6	0.928	5.803	73.412						
7	0.865	5.403	78.815						
8	0.743	4.644	83.459						
9	0.671	4.191	87.650						
10	0.417	3.103	90.753						
11	0.395	2.603	93.353						
12	0.295	1.843	95.199						
13	0.272	1.703	96.902						
14	0.218	1.364	98.265						
15	0.174	1.085	99.351						
16	0.104	0.649	100.00						

Extraction Method: Principal Component Analysis

The first factor accounted for 31.877% of the variance, the second 13.46% and the third 8.749%. The first principal component is strongly correlated with five of the original variables. It increased with the increase in training for employees, care toward the records of tests and inspections, using environmentally friendly products and materials, and care towards environmental issues. This component can be the measure of the environmental factor. From the Table 8.5, it can be seen that the first principal component or environmental factor correlate most strongly with environmentally friendly material and environmentally friendly products.

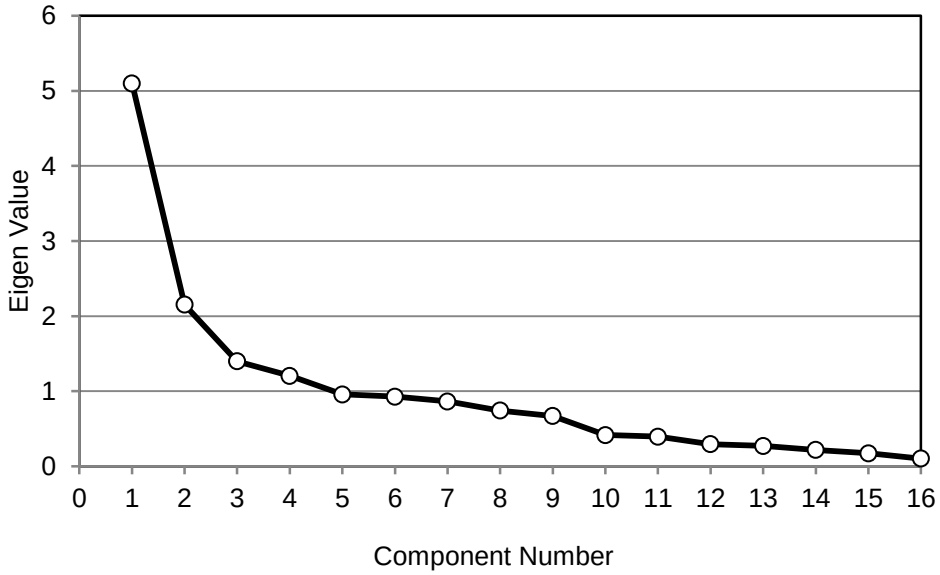


***Figure 8.1*: Scree plot**

The second principal component increased with only five factors namely, approach towards the procedures of green certification programme, usage of the scientific method in all the process, implementing a conventional mechanism for measuring customer satisfaction, and care toward the insertion of alien species. This component can be a measure of the social factor under sustainability. Care towards the insertion of alien species is having higher factor loading.

The third principal component increased with increasing customer satisfaction, adoption of marketing strategies and decreases in competition in the market, and increases with the mechanism for receiving customer complaints. Together these four variables can be a measure of the economic factor of sustainability in this study.

A correlation value above 0.5 is deemed necessary. As per this analysis, the variables quality of the product and relationship with suppliers were regarded as insignificant due to the lower correlation value.

Table 8.5: **Rotated Component Matrix[a]**

Variable	*Component 1*	*Component 2*	*Component 3*
Customer Complaints	0.390	0.375	**0.635**
Green Certification Programme	**0.528**	**0.651**	0.323
Quality of the Product	0.346	-0.465	0.363
Scientific Method	-0.177	**0.510**	0.137
Customer Service	-0.129	-0.226	**0.720**
Employees Training	**0.575**	0.277	0.071
Inspection Records	**0.623**	0.326	0.534
Approach Towards Environmental issues	**0.591**	0.475	-0.286
Environmental Friendly Products	**0.638**	0.276	0.089
Relationship with Suppliers	-0.436	0.069	-0.017
Measuring Customer Satisfaction	0.131	**0.678**	0.282
Degree of Customer Satisfaction	-0.032	**0.542**	**0.513**
Environmental Friendly Materials	**0.634**	-0.085	0.379
Marketing	-0.078	0.230	**0.585**
Competition in Market	0.111	0.107	**0.783**
Alien Species	0.185	**0.715**	0.026

Extraction Method: Principal component analysis
Rotation Method: Varimax with Kaiser Normalization
[a]Rotation converged in 6 rotations

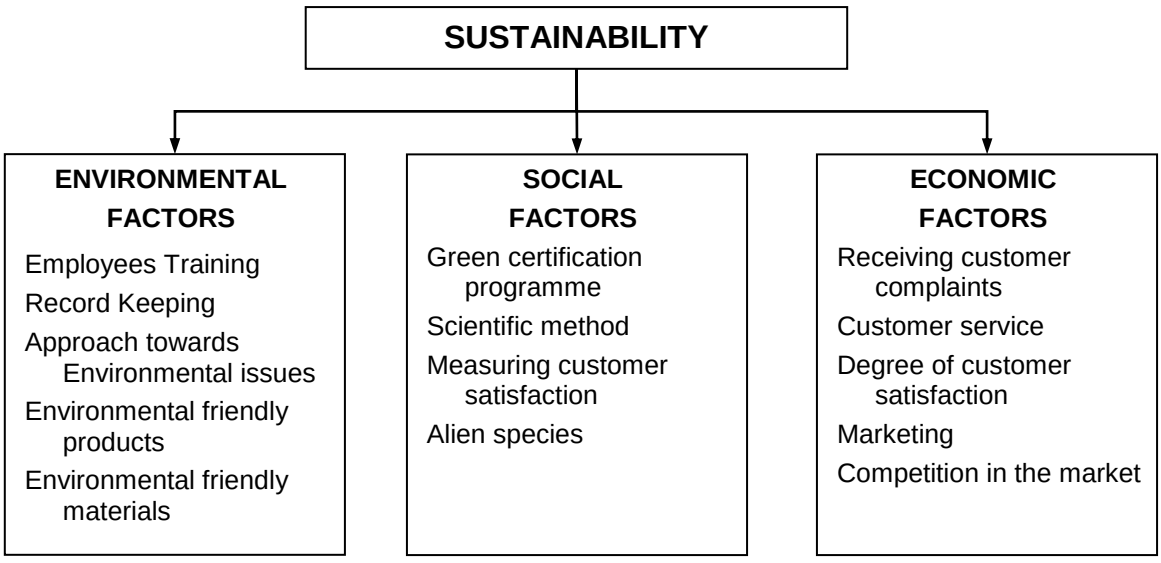


Figure 8.2**: Resulting Sustainable factors of ornamental fish supply chain**

8.5 Analysis of Data

Analysis of the data about the factors and variables identified using factor analysis is described in this section. Description of the tests conducted to determine whether the three factors of sustainability were depended on the Educational qualification, Age and Number of years of experiences of the respondents. Respondents were classified into groups based on the levels of Educational qualification, Age and Number of years of experience. Tests were conducted to verify whether such groupings were significant, and also to identify the existence of significant differences between the pairs of groups.

8.5.1 Descriptive Statistics of Sustainability Factors

The descriptive statistics of the data namely the mean and standard deviation of the responses for variables under the three factors are presented in Table 8.6. The variable, 'using environmentally friendly products' has the highest mean value of 3.7423 with standard deviation 0.72569 is the environmental factor. Another major variable having high mean value in the environmental factor is 'the usage of environmentally friendly materials' with mean 3.7113 and standard deviation 0.81597.

Table 8.6 : **Descriptive Statistics**

Variable	***Mean***	***Std.Dev***
Environmental Factors		
Employees Training	2.9381	0.82682
Record Keeping	2.8041	1.08627
Approach Towards Environmental issues	3.5155	0.93668
Environmental friendly products	3.7423	0.72569
Environmental friendly materials	3.7113	0.81597
Social Factors		
Green certification programme	2.1340	1.17818
Scientific method	4.0619	0.60921
Measuring customer satisfaction	3.4227	0.51710
Alien species	3.8969	0.62056
Economic Factors		
Receiving customer complaints	3.4021	0.73115
Customer service	3.5773	0.64283
Degree of customer satisfaction	4.0309	0.50936
Marketing	3.2887	0.84111

Competition in the market	2.7526	1.26681

In social factor, the variable ‘use of scientific methods’ was having a high mean value of 4.0619 with standard deviation 0.60921 along with ‘care about the insertion of alien species’ with mean value 3.8969 with standard deviation 0.62056.

Among the variables of Economic Factors, the mean value for the variable, ‘competition in the market’ was very low on 2.7526. However, the standard deviation of 1.26681 was very high. Majority of the members were not experiencing much of competitions from the market. It was a remarkable measure of the stability of the business as it did not involve the serious threat of competition from the market.

8.5.2 Tests of significance for factors

One way ANOVA was conducted to determine whether the factors of sustainability were varying significantly according to the variation of educational qualifications of the respondents. Table 8.7 gives the results of one way ANOVA conducted for this purpose. Participants were classified into five groups according to their educational qualification as a group of members having a primary education (n=2), secondary education (n=34), higher secondary education (n=28), graduate education (n= 25) and postgraduate education (n=8). There were no outliers as assessed by boxplots, data was normally distributed for each group, as assessed by Shapiro-wilk test (P>0.05) and there was the homogeneity of variances assessed by Levene's test of homogeneity of the variable.

The environmental factor of sustainability is statistically significant with different levels of educational qualification as evident from the F(4,92) value of 3.641 and p-value of 0.008 as shown in Table 8.7. However social and economic factors are not significant with different levels of educational qualifications as the p values obtained are 0.237 and 0.291 respectively.

Results of the tests conducted to verify whether the factors of sustainability were varying according to age are shown in Table 8.8. Participants were classified into three groups with age less than 30 years (n=12), between 30 and 40 years (n= 37) and greater than 40 years (n= 48). The social factor of sustainability is significantly different between age groups as indicated by the F (2,94) value of 3.237 and p-value of 0.044. It is also

inferred that the environmental and economic factors are not significantly different with age groups as their p values are 0.708 and 0.935 respectively.

Table 8.7: **ANOVA for Sustainability Factors on Educational Qualification**

		Sum of Squares	***df***	***Mean Square***	***F***	***p***
Environmental	Between Groups	5.215	4	1.304	**3.641**	**0.008**
	Within Groups	32.942	92	0.358		
	Total	38.157	96			
Social	Between Groups	1.049	4	0.262	1.410	0.237
	Within Groups	17.108	92	0.186		
	Total	18.157	96			
Economic	Between Groups	1.210	4	0.303	1.261	0.291
	Within Groups	22.067	92	0.240		
	Total	23.278	96			

Table 8.8: **ANOVA for Sustainability factors on Age**

		Sum of Squares	***df***	***Mean Square***	***F***	***p***
Environmental	Between Groups	0.279	2	0.140	0.346	0.708
	Within Groups	37.877	94	0.403		
	Total	38.157	96			
Social	Between Groups	1.170	2	0.585	3.237	0.044
	Within Groups	16.987	94	0.181		
	Total	18.157	96			
Economic	Between Groups	0.033	2	0.017	0.067	0.935
	Within Groups	23.244	94	0.247		
	Total	23.278	96			

Table 8.9 shows the results on the test conducted to verify whether the sustainability factors were significantly different with different levels of experience. Total respondents were grouped into three groups with experience of fewer than five years, 5 to 10 years and more than ten years. The results of the ANOVA conducted are shown in Table 8.9. The existence of a significant difference in environmental factor with according to the experience of the supply chain members is evident from the F (2,94) value of 5.589 and with p-value of 0.005. The social and economic factors have no significant difference according to the number of years of experience with p values 0.589 and 0.814 respectively.

Table 8.9: **ANOVA for Sustainability factors on Experience**

		Sum of Squares	***df***	***Mean Square***	***F***	***p***
Environmental	Between Groups	4.055	2	2.028	5.589	0.005
	Within Groups	34.102	94	0.363		
	Total	38.157	96			
Social	Between Groups	0.203	2	0.102	0.532	0.589
	Within Groups	17.954	94	0.191		
	Total	18.157	96			
Economic	Between Groups	0.102	2	0.051	0.206	0.814
	Within Groups	23.176	94	0.247		
	Total	23.278	96			

8.5.3 Tests of significance between groups

The grouping carried out on the level of Educational Qualifications, Age and Years of Experiences were used to identify the existence of significant differences between the pairs of groups. The factors for which one way ANOVA test revealed the existence of significant differences are again tested to identify the existence of significant differences between the pairs of groups. The results of the tests for each factor are explained in the below sections.

8.5.3.1 Groups of Environmental factor of sustainability

Results of ANOVA tests for the environmental factor of sustainability, conducted among the different groups based on the educational qualifications of the respondents are given in Table 8.10. Except for the group having secondary education, the mean value of response for environmental factor increased from primary (3.3±0.42426) to higher secondary (3.4±0.72008) through graduate (3.5520±0.40116) and to postgraduate (3.725±0.337) education.

Table 8.10: **ANOVA Table of Environmental Factor for Educational Qualifications**

Category		***N***	***Mean***	***Std.Dev***	***F***	***p***
Educational Qualification	Primary	2	3.3000	0.42426	3.641	0.008*
	Secondary	34	3.0529	0.65377		
	Higher Secondary	28	3.4000	0.72008		
	Graduate	25	3.5520	0.40116		
	Post Graduate	8	3.7250	0.33700		

Total	97	3.3423	0.63045

Tukey post hoc analysis was conducted on groups based on educational qualifications for the environmental factor. The details of the test results are shown in the Table 8.11. The p-value of 0.017 for the pair of groups 'secondary education' and 'graduate education' and 0.041 for the pair of groups 'secondary education' and 'postgraduate education' indicate that these groups are statistically significantly different with a confidence level of 95%. For all other pairs of groups, the p values are higher than 0.005. It indicates that there is no statistically significant difference between the pairs.

Table 8.11: **Multiple Comparison-Tukey Post Hoc Test for Environmental Factor**

Group Level I	***Group Level J***	***Mean Difference(I-J)***	***P***
Primary	Secondary	0.24706	0.979
	Higher Secondary	-0.1000	0.999
	Graduate	-0.25200	0.979
	Post Graduate	-0.42500	0.897
Secondary	Higher Secondary	-0.34706	-0.163
	Graduate	-0.49906	0.017*
	Post Graduate	-0.67206	0.041*
Higher Secondary	Graduate	-0.15200	0.887
	Post Graduate	-0.32500	0.658
Graduate	Post Graduate	-0.17300	0.953

The mean response for environmental factor increases from 3.2±0.9458 for the group below 30 years, to 3.3568±0.50382 for the 30-40 years of age group and to 3.3167±0.63425 for the above 40 years group as shown in the Table 8.12. There is no statistically significant difference on environmental sustainability between various age groups as indicated by the F (2,94) value of 0.346 and p-value of 0.708.

Statistically significant differences exist in the environmental factor of sustainability between groups based on experience with F(2, 94) of 5.58 and p-value of 0.005 as given in the Table 8.12. The mean response for the environmental factor increased from 2.9826±0.53907 for 'up to 5 years of experience', to 3.4057±0.58105 for '5 to 10 years of experience' and to 3.4974±0.65353 for 'more than ten years of experience'. Results of Tukey Post-hoc analysis conducted for the different experience groups are shown in Table

8.13. Tukey post-hoc analysis revealed that the difference in the mean responses between the groups ‘up to 5 years of experience’ and ‘5 to 10 years of experience’ is statistically significant with p-value of 0.028. The difference in mean responses for the groups having ‘up to 5 years of experience’ and ‘more than ten years of experience’ is also significant with p-value of 0.005. All other group differences are not statistically significant.

Table 8.12: **ANOVA Table of Environmental Factor for age and experience**

Category		***N***	***Mean***	***Std.Dev***	***F***	***P***
Age	Up to 30 years	12	3.200	0.9458	0.346	0.708
	30-40 Years	37	3.3568	0.50362		
	40 Years above	48	3.3667	0.63425		
	Total	97	3.3423	0.642045		
Experience	0-5 Years	23	2.9826	0.53907	5.589	0.005*
	5-10 Years	35	3.4057	0.58105		
	Above 10 Years	39	3.4974	0.65353		
	Total	97	3.3423	0.63045		

Table 8.13: **Multiple Comparison-Tukey Post Hoc Test for Environmental factor**

Group Level I	***Group Level J***	***Mean Difference(I-J)***	***P***
0-5 years	5-10 Years	-0.42311	0.028
	10 Years above	-0.51483	0.005
5-10 Years	10 years above	-0.09172	0.791

8.5.3.2 Groups of Social Factor

A one way ANOVA was conducted to determine if the social factor of sustainability was different for groups of different educational qualification, age and experience levels.

Results of one way ANOVA test conducted to determine the existence of statistical significance between different educational level groups and social factor of sustainability is as shown in Table 8.14. There is no significant difference with different educational qualification groups as evident from an F(4,92) value of 1.410 and p-value of 0.237. Hence educational qualification does not have a significant effect on the social factor of sustainability.

Table 8.15 shows the results of the ANOVA test conducted for social factor of sustainability with different levels of age and number of years of experiences. The social factor of sustainability is decreasing from 3.8125±0.62272 for 30 years of age, to 3.5270±0.43214 for 31 to 40 years and to 3.4635±0.35726 for more than 40 years of age. There is a significant difference between different age groups on social factor of sustainability as evident from the F (2,94) value of 3.237 and p-value of 0.044. However there does not exist any significant difference in the social factor of sustainability based on the experience of the respondents as the F(2, 94) value and p-value are 0.532 and 0.589 respectively. Tukey post-hoc test results shown in Table 8.16 revealed that the differences of mean responses for the group up to 30 years of experience and above 40 years is is statistically significant with p-value of 0.0333 at 95% confidence level.

Table 8.14: **ANOVA Table of Social Factor with educational qualifications**

Category		***N***	***Mean***	***Std. Dev***	***F***	***P***
Educational Qualification	Primary	2	3.5000	0.000	1.41	0.237
	Secondary	34	3.4338	0.36571		
	Higher Secondary	28	3.5000	0.52705		
	Graduate	25	3.6200	0.43373		
	Post Graduate	8	3.7813	0.31161		
	Total	97	3.5309	0.4349		

Table 8.15: **ANOVA Table of Social factor with Age and Experience**

Category		***N***	***Mean***	***Std. Dev***	***F***	***p***
Age	Up to 30 years	12	3.8125	0.62272	3.237	0.044
	30-40 Years	37	3.5270	0.43214		
	40 Years above	48	3.4635	0.35726		
	Total	97	3.5309	0.43490		
Experience	0-5 Years	23	3.4674	0.30437	0.532	0.589
	5-10 Years	35	3.5857	0.39269		
	Above 10 Years	39	3.5192	0.52997		
	Total	97	3.5309	0.43490		

Table 8.16: **Multiple Comparison-Tukey Post Hoc Test for Social factor**

Group Level I	***Group Level J***	***Mean Difference(I-J)***	***P***

Up to 30 years	31-40	0.28547	0.113
	40 above	0.34896	0.033
31-40	40 Above	0.06349	0.774

8.5.3.1 Groups of Economic Factor

A one way ANOVA was conducted to determine whether the economic factor of sustainability was different for groups with different educational qualification, age groups and experience levels.

The results of ANOVA conducted on the economic factor of sustainability are shown in Table 8.17. The mean value of the economic factor increases from primary education to postgraduate education. However the F(2,92) value of 1.261 and p-value of 0.291 confirm that there these differences are statistically not significant.

Table 8.17: **ANOVA Table of Economic Factor with Educational Qualifications**

Category		***N***	***Mean***	***Std. Dev***	***F***	***P***
Educational Qualification	Primary	2	3.1	0.42426	1.261	0.291
	Secondary	34	3.1706	0.52831		
	Higher Secondary	28	3.3143	0.50311		
	Graduate	25	3.352	0.48744		
	Post Graduate	8	3.5500	0.4142		
	Total	97	3.2887	0.49242		

Results of the ANOVA tests conducted on the Economic factor of sustainability for the different levels of age and experience are shown in Table 8.18. The mean value of economic factor of sustainability decreases as shown in the, from 3.333±0.70496 for the age group ‘up to 30 years’, to 3.2919±0.49124 for ‘30 to 40 years’ and to 3.275±0.43978 for ‘above 40 years’. The mean value is different for different levels of experience. The higher p values for both the categories indicate that these differences in mean responses for groups based on age and experience are statistically not significant.

Table 8.18: **ANOVA Table of Economic factor with Age and Experience**

Category		***N***	***Mean***	***Std.Dev***	***F***	***P***
Age	Up to 30 years	12	3.3333	0.70496	0.067	0.935
	30-40 Years	37	3.2919	0.49124		
	40 Years above	48	3.2750	0.43978		
	Total	97	3.2887	0.49242		
Experience	0-5 Years	23	3.2348	0.54155	0.206	0.814
	5-10 Years	35	3.32	0.43979		

Above 10 Years	39	3.2923	0.51676
Total	97	3.2887	0.49242

8.6 CONCLUSION

Factor analysis of the variables sustainability of ornamental fish supply chain is explained in this chapter. The variables were grouped into three factors namely environmental, social and economic factors of sustainability. The most relevant variables in the environmental factors of sustainability are the ‘usage of environmentally friendly products’ and ‘environmental friendly materials’. In the social factor of sustainability, the important factors are the ‘follow up of scientific methods in all the processes and ‘care about the insertion of alien species’. The extraordinary measure in the economic criteria is the ‘lack of competition in the market’ and ‘customer satisfaction’. Some of the suggested variables are not important are ‘quality of the product’ and ‘relationship with suppliers’.

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GOVERNMENT ENGINEERING COLLEGE THRISSUR

DEPARTMENT OF MECHANICAL ENGINEERING

PERFORMANCE MEASURMENT, RISK ASSESSMET AND MARKETING OF ORNAMENTAL FISH SUPPLY CHAIN, KERALA

Questionnaire:

ID No: : 005 Date of survey: 25/11/2015.

Type : ☐ Breeder ☐ Wholesaler ☑ Retailer

Name of the firm : A.J. Aquarium.

Address (firm) : Keralapuram Kollam Kerala.

: .....

Mob Number : Email ID: 9946524756.

Personal Information

1. Name : Jaffer
2. Address : Palavilaveedu elampallor Kundara
3. Religion : ☐ Hindu ☑ Muslim ☐ Christian
4. Community : ☑ OBC ☐ SC ☐ ST ☐ Others
5. Sex : ☑ Male ☐ Female
6. Age : 40
7. Marital Status : ☐ Single ☑ Married
8. Educational Qualification : ☑ Primary ☐ Secondary ☐ Higher Secondary ☐ Graduate ☐ Post Graduate
9. Ornamental fish trade job category? ☑ Primary ☐ Secondary
10. Do you have any other source of income? ☐ Yes ☑ No

    If yes, specify the source .....
11. Starting year of the trade 2006

Trade Information

12. List major Ornamental fish varieties in your trade? (Up to 10 numbers)

Name of the Ornamental Fish			
1	moly ✓	6	angel. ✓
2	Tigers ✓	7	Guppy ✓
3	fighter	8	neon tetra.
4	Discus. ✓	9	Arona. ✓
5	Twit ~~fool~~ gold ✓	10	fighters ✓

13. List three major popular ornamental fish varieties? (Decreasing Order)

Name of the Fish			
1	Gold fish. ✓	3	Arona.
2	Oscar.	4	neontetra.

14. List three major profit giving ornamental fish varieties? (Decreasing Order)

Name of the Fish			
1	Gold fish.	3	neontetra
2	Molly	4	Karp.

15. List out three major problems facing in Ornamental fish Trade? (Decreasing Order)

1	Quality fishes
2	Water condition
3	disease.

Performance Measurement

16. Our firm can meet short order to delivery cycle time
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☑ d) Majority times ☐ e)Always ☐

17. Our firm has the ability to change the volume of the product as per the variance in demand.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d) Majority times ☑ e)Always ☐

18. Our firm has constant mechanism for receiving customer complaints.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d) Majority times ☐ e)Always ☑

19. Our firm giving responsiveness customer support as per the requirement of the customers in proper time.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

20. Our firm has a good mechanism for forecasting demands.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

21. Our firm has the ability to provide customer orders with in a specific time even if the product is currently not in hand.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☐ e)Always ☑

22. Our firm follows the procedure prescribed by green certification in all the activities.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

23. Our firm regularly maintaining the quality of the item by scientific prescriptions.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☑ d)Majority times ☐ e)Always ☐

24. Our firm is very much careful about the diseases and its symptoms on each variety.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

25. Our firm very careful about the requirement of food and medicine for each variety.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

26. Our firm always using scientific methods for all the processes (Water change, food, medicine, oxygen etc.)
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d) Majority times ☑ e) Always ☐

27. Our firm always ready to give service to the customers
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☑ d) Majority times ☐ e) Always ☐

28. Our firm always prefer experienced employees
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d) Majority times ☑ e)Always ☐

29. Our firm providing proper training for its employees
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d) Majority times ☐ e) Always ☑

30. Our firm always keeping records of tests and inspections
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d) Majority times ☑ e) Always ☐

31. Environmental issues are the main concerns in our firms consideration
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d) Majority times ☐ e) Always ☑

32. Environmental friendly products and services are our firm's objective.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d) Majority times ☑ e) Always ☐

33. Our firm provides fast response to the customers
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e) Always ☐

34. Our firm keeping customer requested date and time for delivery.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

35. Our firm has very good relationship with suppliers.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

36. Our firm and suppliers have common objective in business
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☐ e) Always ☑

37. Our firm has a very high degree of satisfied customers.
a) Not at all b) Very rarely c) Sometimes d)Majority times e)Always

38. Our firm has a regular mechanism for measuring customer satisfaction.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

39. Inventory cost has a significant impact in the total cost of ornamental fish Supply Chain.
a)Not at all ☐ b) Very rarely ☐ c) Sometimes ☑ d)Majority times ☐ e)Always ☐

40. Packaging and transportation cost have a significant role in the ornamental fish supply chain.
a)Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

41. Our firm using marketing (advertisement, Notices, new media) and promotional (discount sale, offers etc.) activities to increase the sales.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

Risk Assessment

42. Mark the macro level risks associated with your firm (Order as per the priority, give rank 1 for most effected risk)

Natural disaster	☑	2
Diseases/ Health Hazards	☐	3
Political Unrest	☐	5
Terrorist attacks	☐	6
Government Regulations	☐	4
Labor Risks	☑	1

43. Mark the demand risks associated with your firm

Sudden loss of demand	☑	1
Volatile demand	☐	3
Change in customer taste	☐	4
Communication failure with customers	☐	5
Inability to meet demand	☐	2
Error in forecasting (Inability to predict demand)	☐	6

44. Mark the supply risks associated with your firm

Communication failure	☑	1
Partnership failure	☑	2
Absence of supplier strategy	☐	4
Absence of competent suppliers	☐	3
Absence of suppliers with common objectives.	☐	5

45. Mark the Quality risks associated with your firm

Testing for suppliers quality rating	☑	1
Maintenance of quality	☐	3
Maintenance of proper documents	☐	4
Lack of skilled persons	☐	5
Facilities for keeping good quality products	☐	6
Facilities to give proper training for employees	☑	2

46. Mark the risks associated with assets and infrastructure

Excessive inventory	☑	1
Under-utilized capacity	☐	5
Inward logistics	☐	4
Outward logistics	☐	3
Usage of hazardous materials	☐	6
Non availability of proper packaging materials	☐	2

47. Our firm use environmental friendly materials.
a) Not at all ☐ b) Very rarely ☑ c) Sometimes ☐ d) Majority times ☐ e) Always ☐

48. Our firm very careful about the species of ornamental fish diversities and its effects on local ecology.
a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

49. Mark the major financial risks

Investment	☑	1
Profit	☑	2
Return on Investment	☐	3
Ownership	☐	5
Government funding	☐	6
Lack of proper training	☐	X

Marketing

50. Number of ornamental fish varieties trading by our firm
    a) Less than 10 ☐ b)10-20 ☑ c)20-30 ☐ d) More than 30 ☐

51. Weekly Turnover of our firm is
    a)Less than 5000 ☐ b)5000-10000 ☑ c)10000-25000 ☐ d) More than 25000 ☐

52. List out the profit share in decreasing order

    a) Ornamental fish trade 3
    b) Packaging materials 5
    c) Aquarium preparation 2
    d) Sales of accessories 1
    e) Service 4

53. Our firm using the market promotional schemes (select more than one if required)

    a) TV advertisement ☐
    b) Newspaper advertisement ☐
    c) Advertisement through new media (facebook,Whatts up) ☐
    d) Through Notices ☑
    e) Visiting Cards ☑
    f) Any other specify ☐
    g) Not using any marketing Schemes ☐

54. Our firm giving sales promotional offers by (select more than one if required)

    a) Discount ☑
    b) Door delivery ☐
    c) Free maintenance ☐
    d) Replacement of death items ☐
    e) Other,.....

55. Our firm has positive result by market promotional schemes
    a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

56. Promotional offers positively result the sales and revenue.
    a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e) Always ☐

57. Average number of sales per week
    a) Less than 10 ☐ b)10-20 ☐ c)20-30 ☑ d) more than 30 ☐

58. Our firm careful about the trade of banned species.
    a) Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d) Majority times ☑ e) Always ☐

59. Our firm feels competition in the market
    a)Not at all ☐ b) Very rarely ☐ c) Sometimes ☐ d)Majority times ☑ e)Always ☐

60. Our firms market is
    a) Domestic ☑ b) Export ☐ c) Both ☐